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DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

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EDITORIALS

COMPETITIVE BIDDING BETWEEN ENGINEERS

Recently, in these columns, we stated our editorial policy with respect to competitive bidding between engineers by saying, in substance, that in our opinion the practice of asking consulting engineers to bid against each other for a piece of work is bad and should be discouraged. We still hold to that view, but the subject is so important that it merits full discussion. The present discussion is inspired by a friend who has a disconcerting faculty for putting his finger on the fallacy in an argument. He is inclined to favor competitive bidding between engineers as the natural and proper way for the deserving younger men to get jobs. Before discussing this particular phase of the matter it may perhaps be desirable to state more fully why we are opposed to the practice.

It is not so much the element of competition in the bidding that is objectionable as it is the nature of the bidding and the attendant circumstances. On many, perhaps most, jobs where a consultant is to be called in, there is some competition; proposals are asked from two or more engineers. This, however, is done quietly and somewhat informally without advertising the job and inviting everybody and his brother to come in and join in a competitive bidding contest in hammering down the price. If a city council asks a firm of engineers to name a figure for a certain job, the engineers are likely to set a price that will enable them to do a good job for the city at a profit for themselves. Under such circumstances the engineer in fixing his price will feel that he is the only one asked to name a figure, or is one of a very few, so he is inclined to keep his fee up to a proper standard. But where the job is widely advertised and, as stated, brought to the attention of every engineer, the price any man asks is very likely to be substantially lower than it should be. In fact there would seem to be no argument necessary to show that the very purpose of open competitive bidding is to hammer down the price. This practice might be justified if fees were generally too high, but they are not. Now since the object of open bidding is to keep fees low, and as this object is attained, we condemn the practice because the fees are thereby forced down to the point where the successful bidder either cannot do a good piece of work or cannot make a profit from his work. It seems this is a condition as bad for the public as it is for the engineer.

Probably the one thing most injurious to the welfare of the engineer is the popular notion that one engineer is as good as another and that once any engineer is employed at any price he can and will, by some mysterious process, do all that could be expected of him. Open competitive bidding is an expression of this fallacious belief; this seems sufficient reason for condemning it. Money saved on an engineer's fee is often very expensive money.

Now with all due respect to the great engineers of the country we do not believe that they should get all the work. As a matter of fact they do not get it all. Younger men should have their chance to establish themselves and they do have that chance and always have had it, without recourse to open competitive bidding. In fact the better class of rising young engineers will establish itself more quickly without competitive bidding than with it. The man who intends to do an honest and skillful piece of work is at a distinct disadvantage in open competition with the man who expects to do a shady piece of work in a slip-shod manner.

There are various ways for the young consultant to get business without plunging into the whirlpool of open competitive bidding. He can build up confidence in his integrity and ability by becoming acquainted with those in position to employ him. Naturally most of his early opportunities will be close to him where he is best known. He will learn of opportunities in nearby places and can then present his claims for consideration in a dignified way by letter or by personal interview. We believe most young consultants who have achieved success have started in this way.

THE ENGINEER AND UTILITY OWNERSHIP

Probably a large majority of engineers favor private ownership of public utilities; at any rate, that is the impression gained from many years of discussion of this subject with engineers in all parts of the country. It is interesting to consider the reasons for this and to inquire whether or not the engineer is likely to change his mind on this subject.

The conditions of employment under both private and public ownership are well understood by engineers. Generally speaking, the rewards paid to those who make a success under private ownership are greater than are paid to those who serve equally well under public ownership. Again, the man who makes good under private ownership is likely to hold his job as long as he wants it, while the man who makes good under public ownership may lose his job at any time it serves the purpose of his superiors to turn him out. These are the fundamental reasons for the preference of the engineer in respect to utility ownership, and they are good reasons, easily understood.

Looking under the surface, however, one is impressed with the fact that the engineer's reaction in the premises is merely that of the servant who appreciates good pay and steady work. If the engineer exercised the qualities of a master would he still prefer private ownership?

Under private ownership the large reward goes to the capital invested, if the utility is prosperous. Under public ownership, where service rather than profit is the end sought, the large reward should go to management, although it does not now go to management as a rule. But it is likely that when the engineer finally asserts himself and goes before the public with the statement that he is best qualified to make a utility produce maximum service at minimum cost, but that he will demand adequate compensation for doing so, he will be better off under public ownership. Until he is ready to fulfill his destiny, in this field, he will do well to continue his preference for private ownership. The editor hopes to be on the side-lines, leading the cheering, when the engineer announces the end of his period of apprenticeship and claims his reward.

REGULATING PARKING OF AUTOMOBILES

An exceptionally interesting article on the parking of automobiles is published in this issue. This article is so good that the man who set the type and the lady who read the proof both spoke to the editor about it. This is the perfect tribute and may be regarded as the attainment of the ultimate in praise.

We do not wish to do more here than to call attention to Mr. Ihlder's remarkably interesting and helpful discussion of one of the most difficult problems of our day. The officials of almost every city are now struggling with this problem and every reader is sure to derive benefit from the article, no matter what part he plays in the game of traffic regulation, whether he regulates or is regulated.

DISTRICT HEATING

We have been pleased to present to the readers of this magazine several good articles on district heating. More such articles are wanted and engineers and city and utility officials who have had experience in this line are especially urged and invited to contribute to the discussion of this important and timely subject. A valued correspondent calls our attention to the need for greater uniformity in the terminology of this subject. He states that he has often wondered why reference to the matter of heating a group of buildings, either by steam or water, from one plant is not referred to always by the same term. Some say "central station heating" or "community heating," while others prefer "block heating" or "group heating," and still others prefer "district heating." The latter term has much to recommend it. For instance, over ten years ago a national association was formed by the various companies selling heat and the name decided upon for this organization was the "National District Heating Association." It is felt that District Heating is the best term to designate the heating of several buildings from one heating plant and the term will be so employed henceforth in this journal.

COMPLETE RECONSTRUCTION OF DOWN TOWN STREETS OF SPRINGFIELD, ILL.

By Wade D. Seeley, City Engineer, Springfield, Ill.

The City of Springfield, Illinois, has taken quite a stride in the last few years in the development of her streets. Somewhere between 25 and 60 per cent of the entire built-up area of the average American city is in its streets; and in them is to be found one-third (in value) of all its property also. Every citizen is dependent, in his business, and his very existence, upon the streets, the traffic on them and the conduits under them. Consequently mistakes made in the laying out or original construction of a city's streets entail on all its citizens unnecessary discomfort and expense for all time.

Original Pavements

The first paving laid in Springfield was during the year 1878 when cedar blocks were laid on hemlock planks 2 ins. thick. Various grades of wood were used and several miles of the main streets were paved with red cedar laid on oak planks up until 1886. During the year 1887 the first brick pavement was laid for an experiment and it was judged superior in every respect to white cedar blocks.

Various changes in the paving specifications were made in later years and during the years of 1892 to 1895 the main streets and the entire business district were repaved with the most modern brick pavement at that time. (Two course work or brick on edge set on brick laid flatwise). These pavements have resisted the wear of traffic for 28 years, and in places where the pavement has not been disturbed for underground construction, are still in fair shape.

Need for Reconstruction

In the last few years, this city, like most cities and towns which were planned before the motor made its appearance, commenced to grapple with its traffic problems, and with the fact that an adequate street plan may cost large amounts. It must be borne in mind that the outlay today will be less than it will be two or five years hence. Our Chamber of Commerce and Civic Leagues have recognized the fact that any poorly paved city will drop back, and those streets and sections which are not applying the remedies are certain to fall into more or less disuse, with corresponding reduction in property values.

Survey

The city commissioners, attorneys and engineers held a conference and laid plans for the big improvement program. The first move was to prepare an exact survey of all underground structures in the streets. Plats were drawn to a large scale and the maze of pipes and conduits under the pavements was shown.

Ornamental Street Lighting

The first improvement made was an ornamental street lighting system covering the entire business district to be improved. Nearly 400 standards were set, and care was used in alignment as regarding future widening of streets. The improvement was made under the Special Assessment Act, and the cost covering the same was spread over a period of three years.

Heating Mains

New steam and hot water mains were next installed. The latest materials for heating mains were used, and great progress was made in constructing the work during the short period the heating mains were shut off for the summer months. One circuit of the main artery of the heating system leading from the Central Power Plant for a distance of eight blocks cost over $250,000 and was constructed in three months.

All electric wires owned by public utilities and the City were placed in separate conduits, and all electric transformers were installed in large concrete manholes, placed out of the street under the sidewalks.

Water and Gas Mains

The cast iron water mains and lead service pipes were all renewed and in some places enlarged. Six inch cast iron water mains were replaced with 16 in. mains, and the fire hydrants were enlarged and re-set, affording a more adaptable place in fighting fires.

The gas mains were also enlarged and service pipes leading to various buildings were renewed.

Sewerage

In the midst of all the tearing up, the sewers were not overlooked. On some streets new sanitary sewers were laid to a depth of 18 ft. and house connections of either 12 or 8 in. sewer pipe were provided for each parcel of land along the improvement.

Street Railway Reconstruction

After all the underground structures were completed, or carried on in advance, the Street Railway Company work was

started on the tracks and carried on both night and day. The old tracks of light rails and hand-mixed concrete laid in 1903 were ripped up from one end to the other. New intersections, typifying the best in modern methods, were used of manganese steel wieghing 127 lbs. to the yard. Some intersections, 100 pieces of curves, frogs, switches, crosses and straight tracks were completed at a cost of $29,000.

Several different methods of track construction were used. The roadbed was first drained with a 6 in. field tile. Upon this a 6 in. Portland cement concrete slab was laid according to the formula of 1 part Portland cement, 4 of washed gravel and 2½ parts of sand. Crushed stone ballast was laid on the concrete slab and the ties were concreted in place. Several thousand feet of tracks were laid by placing 4 ins. of crushed stone upon a tiled roadbed and concreting the ties in place, using the same formula for the Portland cement concrete. Then, again, the rails were brought to proper grade by using wooden block under the ties while the concrete was poured around the ties and tamped in place.

Car Track Paving

Granite blocks, 3½ ins. in depth were substituted for rail bricks and the balance of the tracks were paved with 3½ in. vitrified paving brick laid flatwise. The interstices of the brick were filled with an asphalt filler. Cast iron track drains were used at the necessary places and electric switches were included in the work.

While the track laying was in progress, steam shovels were removing the subgrade in preparation for the paving work.

Street Widening

The old stone curbing was removed and the street widened to a width of 48 to 64 ft. Care was used in having each particular street widened to a uniform width, but in a few cases it was impossible to follow this rule. All corners were enlarged to 16 ft. radius, except at intersections near fire engine houses, where 22 ft. was used. All storm water inlets were trapped to the main sewers and direct connections were made to the nearest sewer and manholes were placed over the inlet pipe at convenient places.

A Portland cement concrete curb was used having a thickness of 6 ins., except at street corners, where a thickness of 8 ins. was placed to receive the greater wear.

All excavations were thoroughly flooded with water, and in most cases where deep excavations were encountered the flooding was carried out several times, to insure a solid roadbed. A light 3 to 5-ton roller was first used before the heavy 10-ton roller completed this work.

Washed gravel and sand were trucked to the concrete mixer and the cement was added at the machine.

Upon the main streets having the major portion of excavations in the underground work, 8 ins. of Portland cement concrete was used, having a 1 to 7 mix. In the balance of the streets 6 in. foundations were used.

Brick Paving

The paving bricks of 3½ in. depth were laid flatwise and an asphalt filler was squeegeed over the whole surface and a light top dressing of sharp fine sand was used.

The original plan for this local improvement was outlined to cover a period of four years. Two years have now elapsed and the work has been carried on like clock work. Weather conditions have caused more delay this year than last, but the excessive rains have helped settle the earth excavations.

Some Car Tracks Discarded

In order to clear the streets of unnecessary street car tracks without seriously hampering trolley service, 13 blocks of car tracks were abandoned.

In the central portion of the City the streets improved around the Lincoln Square were widened 12 ft. by extending the paved portion of the street to the building line. The sidewalks were constructed inside the lot, and adjacent to the curb line. It was thus planned that ample space would be available for vehicle parking place. Two sides of Lincoln Square have now been completed, and the streets have been opened to travel. The 12 ft. space has been properly utilized and has greatly helped in handling traffic in this congested district.

Balance Between Street and Sidewalk Width

Some question has arisen as to the proper width that should be allowed for walk space for pedestrians. Some 48 ft. paved portions of streets are now planned to be widened 4 ft. on each side, so as to leave 12 ft. of space on each side of the street. The members of the city council have passed on the question that 12 ft. is sufficient for a walk space. Some merchants claim that excessive widening of

streets should not be permitted, and that the city officials should have as much consideration for pedestrians who use the sidewalks by the thousands as for the vehicles which use the roadway by the hundreds.

It is a great question, but we have planned to help conditions that exist today. The cost has run into large amounts as over $250,000 was expended last year for paving in the down town district, and the cost will run about the same amount for this year.

ROAD AND PAVEMENT DRAINAGE A NECESSARY ECONOMIC INVESTMENT

By J. W. Howard, C. E., E. M., Consulting and Testing Engineer on Roads and Pavements, 1 Broadway, New York, N. Y.

Increasing attention is being given to proper drainage of the subsoil under and adjacent to roads and pavements. Every portion of the location of a pavement or road must be studied by a competent engineer to determine in advance of construction or improvement the portions which will have to be properly drained by permanent installations underground and water which does the damage either as a sometimes otherwise in order to prevent water from being the prime cause of injury, if not destruction of the road or pavement. In 1902 the writer stated, in an article entitled "Pavements Injured by Water," that "the principal cause of injury to many pavements and roads is water which does the damage either as a liquid, or by freezing. It makes it possible for traffic to do great damage by the water first softening or loosening a pavement. Traffic of vehicles, which a casual observer thinks does the most damage, is of itself less injurious than water. A pavement once uneven from moisture or frost is easily and rapidly further spoiled by traffic. Pavements laid and maintained so that water can do them little harm are very slowly affected by traffic. * * * A well laid pavement requires a subsoil drained naturally or artificially. Water below a pavement or road undermines or softens the subsoil, causing settlements. It freezes and forces up irregularities in the surface. Water often works up through concrete foundations and gathers in various ways on its upper side, thus getting between the foundation and the stone, brick, asphalt, etc., pavement surface layers. Water thus displaces, disintegrates and weakens the entire structure. A solid, dry and compact subsoil is needed for all roadways."

Although more roads and pavements are being properly drained than heretofore, nevertheless, there is great laxity almost everywhere in this respect. This is especially true on streets and roads which have no curbs or protective edgings and other means of preventing water seeping from outside underneath the pavement; especially during periods of heavy rains.

Proper permanent drainage installations costing relatively little, constitute an insurance for the permanence of a road and its pavement and guarantees the ultimate economy of the entire capital invested in the subgrade and foundation: also indirectly, in the wearing surface layer of whatever material it may be on the surface of the street or road. The permanent surface layers of many materials can be economically maintained in constant good condition indefinitely by a little attention from time to time provided the road or pavement has a good foundation and proper lateral and subsoil drainage.

Some of the injuries from water are from the following causes: (1) Insufficient drainage from side ditches; (2) level of the road foundation and surface too little above surrounding country, so that during extremely wet weather, water seeps under the pavement; (3) failure to provide culverts, blind or other cross drains under the pavement to carry water to the side drains or ditches; (4) wherever a road extends along the side or the base of hill, special drains are needed to provide for disposing of spring and underground water on the uphill side of the road and sometimes on the downhill side of the road. If ditches are used on the uphill side, they must be well outside the roadway shoulders and to a sufficient depth below the bottom of the base of the pavement to convey the water to culverts or elsewhere. Subsurface drains at a depth of at least 3 ft., filled with broken stone or large gravel, lengthwise the road and connected with similar drains crosswise the road, are suitable and inexpensive for many locations. The cross drains under the road should be spaced at short intervals of, say, 50 ft., and at longer intervals where the local conditions permit. (5) In some cases where it is believed subsurface water or

seepage from the sides will get under the pavement, it has been doubtful practice to construct blind drains under the center line of the road. Such construction needs many lateral blind drains or other outlets to prevent the center drain from becoming clogged in time and retaining water, which softens the subsoil. In cold climates such water freezes and dislocates the pavement above. It is seldom necessary to provide longitudinal drainage under a road. The same length of drains under the center of the road will provide an ample number of cross drains to fulfill the same function.

Several states have set a good example by preparing plans and specifications for every kind or classification of drainage, the necessity for which can be foreseen; also providing for such additional drainage as may be found necessary during actual construction; prices to be bid upon being per lineal foot in accordance with the plans and specifications for the various kinds and quantities of drains as estimated will be needed; there being a further provision that any extra drainage construction will be furnished, where necessary and ordered in writing, at cost of labor and materials plus 15 per cent. This practically means at cost, because overhead charges of supervision, etc., are not included.

Professor F. H. Eno, of the Engineering Department, Ohio State University, made the following interesting statements in an address he gave at a Convention of the American Road Builders' Association: "(1) There is seldom a paved road which does not provide perfect (surface) cross drainage, at least from the center of the road to the edge of the paved area. Beyond that point, perfection in drainage is difficult of attainment. (2) A perfectly stable, dry, well-compacted soil is necessary to support roads subject to heavy traffic. (3) D. S. Humphrey, of the Ohio State Highway Advisory Board, says that most of the highway engineers are making a serious mistake in cutting through the top soil for their subgrades. If, instead of quibbling about grades, they would build their road foundations on top of the subsoil, they would get very much better support for their roads and at the same time secure better drainage. (4) One argument for placing roads on top of the soil is the fact that greater opportunity for leading surface water away through culverts is provided. It also permits shallower ditches and more fall to the outlets. (5) Advantage should be taken of natural soil drainage by building the road on top of the original soil as far as possible. Minimize the cuts. Multiply the culverts. Conduct the water away from the road into natural channels as frequently as possible."

EFFECTS OF CHANGING AIR TEMPERATURE AND MOISTURE CONTENT ON BEHAVIOR OF PAVEMENT SLABS

By H. W. Skidmore, Consulting Engineer, Chicago Paving Laboratory, 169 N. Wells St., Chicago, Ill.

I have just read the article entitled, "A Different Angle on the Subdrainage of Pavements," contributed to the September number of Municipal and County Engineering by Monroe L. Patzig, and note that he invites discussion of this subject.

The term "moisture expansion" is prominent in the article, and it appears that the author considers this a most likely cause of blow-ups, joint heaves, difference in elevation of slab ends, curling of slabs and other defects common to rigid pavements, particularly Portland cement concrete.

The effect of moisture content in Portland cement concrete is pretty definitely known, and if this were the only factor seriously concerned with the behavior of the pavement slab, it would be a relatively simple matter to design the slab, under the various conditions prevailing in each individual case with respect to moisture, so that the pavement would not suffer directly from this source. Eliminating frost heaving, the defects referred to in the article are manifestations of structural weakness that occur, almost entirely in the hot weather. The effect of changing air temperature is rapidly reflected in the behavior of the slab, whereas, expansion due to an increase of moisture requires long periods of time to assume serious proportions, and the contraction due to evaporation of moisture is even slower.

A situation might be imagined where a slab constructed in dry weather upon a dry subgrade was later subjected to high moisture content for a period of several months. Sufficient stress might be accumulated to cause joint heavage or even actual rupture, and still under especially advantageous conditions some curling of the slab. But the extreme con-

ditions that would be required to accomplish any very serious results from this source are so uncommon that in ordinary practice moisture expansion or contraction will usually require only passing consideration. The exception to this rule is the surface checking due to rapid evaporation of moisture during the setting period; and the seriousness of this defect can be largely, if not entirely, eliminated by proper curing.

Moisture content of the soil, however, is very frequently a most serious factor with respect to the load-supporting power of the subgrade. Its effect varies widely among different soils, not only in separate localities, but even within the limits of a relatively small project. The result may be either to increase or decrease the supporting ability of the soil, depending upon the nature of the soil and the amount of moisture present. Some soils increase their supporting power by absorbing moisture up to a certain optimum amount; this value decreasing when the percentage of moisture is either raised or lowered. Probable moisture content during the cold season must be given serious consideration, because of the possibility of frost heaving and the consequent rupture of the pavement structure.

Decidedly the most serious aspect of the moisture question is its relation to the variability of the load supporting power of the subgrade. It is generally conceded that some drainage must be provided. This usually takes the form of side ditches or drains on highway work and curb and gutter, with or without drains, on city pavements; constructed longitudinally of the pavement in order to intercept and divert, at least the bulk of the water that would otherwise have access to the soil and cause excessive moisture content. In many cases, no doubt, drainage structures have not been entirely adequate. Yet, on the other hand, there are great areas, especially in the middle states, where the soil is of such nature that even elaborate systems of under-drains in addition to the usual provisions for removal of surface water have proven of very little, if any, value in reducing the moisture content of the soil below an amount that seems fairly constant from season to season, and is considerably in excess of that which would render the soil anything like par with respect to supporting value, when compared with other soils. The Bates Road Tests have rather clearly demonstrated this fact. Obviously, there is one solution in such cases that will unquestionably provide a permanently stable support. That is the construction of a sub-foundation or subgrade of gravel, broken stone, etc., not primarily for the purpose of providing drainage but to supply the required under-support. The situation will, without doubt, be met with some such solution as soon as it is found that in the long run it will prove to be more economical than attempting to build a rigid slab equal to the situation in all respects.

Relative to the curling action of concrete slab, Mr. Patzig says:

"* * * But with moisture expansion there is a decided tendency for the concrete slabs to curl upwards due to the greater expansion on the lower surface than on the upper one.

"This curling action can be more pronounced in concrete pavements than on concrete base under other types of pavement surfaces, because there can be greater differences between the moisture or humidity of the two surfaces."

It must be taken that he refers, in the second paragraph above, to the under side of the slab in both cases. And if so it would appear that there is a discrepancy in the statement. Providing both types, that is an uncovered Portland cement concrete and, say, an asphalt surface on Portland cement concrete base, existed under the same soil and moisture conditions, and the air temperature at the surface in both cases was the same; he apparently means to say that the curling would be greater in the case of the uncovered concrete because the moisture or humidity would be greater on the underside of that slab than would be the case with the concrete base slab. There would seem to be absolutely no reason for such an assumption. In fact, if there was any difference at all, the reverse would be true, owing to the much lower rate of surface evaporation in the case of the moisture-proof asphalt top. This theory will not account for the fact that uncovered Portland cement concrete slabs curl and warp more than those that are topped with another type of wearing surface. The reason is that in the case of asphalt top, we have an insulating blanket, which not only greatly reduces the rate of temperature penetration, but also prevents the rapid evaporation of moisture.

Portland cement concrete pavement slabs curl up at the edges at night, due

to the fact that the upper surface is rapidly cooling off and is in the process of contraction, whereas, the bottom of the slab, not being in direct contact with the air tends to retain its heat and consequently does not assume the same rate or degree of contraction as the upper side. Conversely, during the heat of the day, the slab is warped in the other direction, often lifting free from the subgrade at the center. This is, of course, due to the fact that the top surface is expanding much more rapidly than the bottom. The whole performance simply illustrates the effect of changing air temperature in developing varying stresses in the structure. It occurs much too rapidly to be due to moisture expansion.

During expansion the slab between joints may be said to be in compression, with the force acting longtitudinally through the slab. The construction joint is almost inevitably a weak section, consequently most of the heaves come there. If the joint is perfect, there is no joint at all, and the rupture will search out the weakest section elsewhere. The raising of one slab end above that of its neighbor may be due to one or more of several causes, e. g. There might be a slight difference in subgrade elevation; the joint may not be perpendicular to the plane of the subgrade; one slab may be a little stronger than the other, or of slightly greater thickness. Perfect joints rather than drainage would seem to be the answer to this defect.

There is now available a vast amount of data relative to the various items mentioned in Mr. Patzig's discussion. There is much more in the making. This will unquestionably result in better pavements. But it still is a big question whether truly rigid types will ever be reduced to that exactness which will render them entirely satisfactory and wholly economical under all conditions.

FACTS AND FIGURES ON COMMUNITY OR GROUP HEATING

By H. C. Kimbrough, American District Steam Co., 712 First National Bank Bldg., Chicago, Ill.

The subject of group or block heating, and the application of the principles of community or group heating in cities large and small, have led to a desire to ascertain the smallest devisible unit of operation which can be successful commercially. For this purpose a detailed investigation of the engineering and commercial factors was promulgated, and I am indebted to Mr. Walter J. Kline, of the American District Steam Company, for his engineering study of this very interesting problem of group or community heating.

The chosen field for observation included two well built residential blocks in a city on the lakes, comparable in every way with districts in Cleveland, and in this report were discussed all of the items involved in the inception, organization, design, construction and operation of a district heating proposition, confined within the limits of a community or block plan; the most important of these items being:

(1) Proper selection of block or district; (2) Volume of space to be heated; (3) Amount of heat required based upon recorded data for similar latitude; (4) Design and cost of proper boiler plant; (5) Discussion of return system and cost; (6) Method of operation, meters, etc.; (7) Cost of operation; (8) Fixed, depreciation and maintenance charges; (9) Revenue to be paid by members of the community; (10) Surplus to be paid to participating shareholders.

The original study included a number of items which have been checked and revised as a result of conference and discussions, as well as a review and checking by other engineers and individuals who were interested.

(1) By running a single steam main with long services, instead of a "loop" with short services, it was found that the cost is reduced somewhat and these figures are used in the estimate herewith.

(2) The value of the water plus the value of the heat in the condensate is insufficient to justify the required investment in return mains.

(3) An ornamental stack can be constructed which will be sufficiently attractive to be proof against reasonable objections. It will add to the cost at least $1,000, which has been included in the revised figures.

(4) In a study of a community or district heating plant, in St. Louis, the idea was proposed of building a community garage with capacity for 15 cars, in which would be located the boilers, likewise room for storage of coal. On the second floor it was proposed to equip an apartment for the man who would be in charge of the garage and the firing of these boilers. Such a building would cost

roughly $25,000 to $30,000 and the rent of garage space would more than provide interest and return on the combined community boiler plant and garage.

(5) From the figures we have eliminated all items of "customer's house piping."

(6) We have eliminated "interest" from the cost of operation.

(7) The item of "coal cost" has been reviewed from the standing of assumed evaporation "steam delivered" to customer on efficiency of operation. Oil burning is out of the question at this time, because of the cost of oil.

(8) It is quite evident that clerical labor, superintendent, fitter, etc., if charged to a single block, will result in a disproportionate overhead. The same organization can look after many blocks, and therein lies the desirability of including ALL the desirable blocks in a district rather than a restricted community. The matter of depreciation and maintenance has been reviewed and is established for the purpose of this analysis as follows:

Insurance and taxes, 2 per cent of the total; depreciation, 4 per cent of the total; maintenance, general, 2 per cent of the total; maintenance, boilers, $2 per h. p. per year.

The following, then, is the statement of cost of construction and operation of a single unit, or block plant. It consists of 42 residences, 4 apartment buildings, one club and nine garages, aggregating 3,630,000 cu. ft. of space, which will require an annual average of 38,090,500 lbs. of steam condensed in radiators and house piping. Based upon an evaporation of 6¾ lbs. of water per pound of coal and an "efficiency of delivery" of 85 per cent, there will be metered 5¾ lbs. of steam per 1 lb. of bituminous coal burned, or approximately 3,300 tons.

The foregoing results are based upon 100 per cent of the existing buildings participating in the community, or block plan of heating, and it becomes at once apparent that the greatest possible "load" should be secured to insure the maximum return on the investment.

Hundreds of community heating plants may be installed throughout the country on the co-operative participating plan, and made self-sustaining, with a fair return on the cost, and providing for upkeep and renewals.

Financially the desirability of pooling the cost of installation and operation of many individual boiler plants, and constructing and operating one central plant, is evident. Why not do away with the annoyances of getting coal, handling ashes, and depending upon irresponsible attendants? Why not have one smoke stack instead of a multitude? Why not enjoy a clean community free from the smoke nuisance and its damage to property and furnishings?

A very worth while item to consider in the presentation of community or district heating is the avoidance of coal storage, in advance of the heating season. The unloading of coal in the basement of the individual house represents a very considerable tying up of money which earns nothing during the winter season.

From the standpoint of the consulting engineer, the cost of a plant or production should not weigh against the desirability of community heating service. The countless community centers in which there are six, ten, a dozen or twenty property owners, whose chief concern is the comfort of dependable heating service and who are able and willing to pay a reasonable charge for the privilege—would be the consulting engineers' field for development of community heating

INVESTMENT AND OPERATION

Cost of 300 H. P. Boiler Plant and Stack			$36,000
Cost of Steam Distribution System (including Trenching)			38,000
Cost of Meters and Valves			3,750
Total cost of Construction			$77,750
Cost of coal—$6 per ton		$19,800	
Cost of teaming coal and ashes		3,300	
Depreciation, Maintenance, Insurance and Taxes—(8%)		6,210	
Maintenance Boilers, etc., $2 per H. P.		600	
Cost of Water		500	
2 Firemen—8 Months	$2,240		
1 Chief—12 Months	1,800		
1 Meter Man and Clerk	800		
Miscellaneous Expense	250	$5,090	
Total Operating, Fixed and Labor charges			$35,510
Income from 38,090,500 lbs. of steam if sold at sliding scale of rate, approximately $1.31 per Thousand pounds (coal $6.50 teamed to power plant) total sales			$49,898
Operating Charges, forward			35,510
Surplus over operating			$14,388
Percentage on Investment, ($77,750) 18.5%			

plants. Every building having at present a heating boiler has a potential beginning of an argument for a community or block plant, because the longer the owner operates this separate unit, with its separate upkeep, labor and annoyance, the more certain is the possibility of interesting him in "buying his heat" from a central community plant, through properly installed underground heating mains; just as has come to be the custom of having water through pipe, gas through pipe, and electricity by transmission into the house, apartment or business building.

We have "backed away" from this very interesting study and development long enough, it would seem, and it is clearly a wide and almost unexplored field of substantial return to the consulting engineer, and his collaborator, the architect.

THE FIRST YEAR OF MUNICIPAL OWNERSHIP OF DETROIT STREET RAILWAY SYSTEM.

By Lent D. Upson, Director, Detroit Bureau of Governmental Research, Detroit, Mich.

(Editor's Note: The results of the experiment in municipal ownership of street railways in Detroit are being carefully watched throughout the country. Many reports both of success and failure to date have been circulated. The present article by Mr. Upson, reprinted here from the National Municipal Review, gives the facts on which the reader can base his own opinion of the merits in this controversy.)

On May 15, 1923, Detroit completed its first year of municipal ownership and operation of a unified street railway system. On this occasion Mayor Frank E. Doremus gave a statement to the press that the system had earned in excess of $1,000,000 during that year. This statement has attracted comment and criticism from two principal sources—first organized and unorganized anti-municipal ownership propaganda which deliberately misinterprets the facts presented; second, from conscientious citizens who want to be convinced that municipal operations have been more successful than private.

Municipal operations in Detroit may be judged by two criteria—financial results and service. It has not been seriously contended that the service under municipal ownership has been worse than under private ownership—probably it has been better—and the storm has raged principally about financial results.

The Financial Record

The municipal street railway system is a unification of 61½ miles of work constructed by the City, and 312 miles purchased from the Detroit United Railways, giving a total mileage of 373½. Outstanding against the system are $19,000,000 in 30-year bonds and a $17,000,000 purchase contract that must be liquidated in 10 years—all such debt charges as well as operating charges and taxes to be paid from earnings. The rate of fare is 5 cts., with 1 ct. for a transfer, giving an average rate of slightly less than 5 1/3 cts. The real financial issue is whether the department of street railways must earn enough not only to liquidate debt charges in excess of $2,000,000 a year, but also to create a depreciation fund sufficient to maintain the plant at present value. It is very questionable whether at the present rate of fare, the municipal railway can meet both charges completely. If, as is contended by some, municipal ownership, to be a success, must meet both charges, probably the discussion need go no further.

However, there is presumably some argument against this contention. No privately owned utility is required to retire its funded debt from earnings. It is questionable whether any public utility commission would permit a rate sufficient for such retirement in addition to providing for depreciation. The Detroit charter does not specifically require that both charges shall be met completely. The charter states that sufficient debt, in the discretion of the board of street railway commissioners, shall be retired so that the system be eventually paid for out of earnings. It is only circumstance that nearly one-half of the system must be paid for within ten years. The drawing upon a depreciation fund for money to pay this debt practically results in refunding it over a longer period of years.

The financial statement for 11½ months' operation substantially in the form submitted by the department of street railways, is as follows:

Operating revenues		$19,067,631.30
Deduct:		
Operating exp.	$13,368,796.72	
Taxes, rent, etc...	634,641.15	
Interest	1,795,487.07	
Sink. fund charges	2,238,070.73	
		18,036,995.67
Net profit carried to surplus		$1,030,635.63

A more practical manner of reporting

would take a form usual in privately owned utilities:

Operating revenues		$19,067,631.30
Deduct:		
Operating exp.	$13,368,796.72	
Taxes, rent, etc.	634,641.15	
Interest	1,795,487.07	
Depreciation	2,000,000.00	
		17,798,924.94
Net profits or surplus available for debt retirement or other purposes		$1,268,706.36

In other words, were this a private utility, it would actually have met all of its depreciation charges and other operating expenses including interest, and had a balance of $1,268,000 as profit. The depreciation is an estimate. It may be more than $2,000,000 a year, but it is probably less. This rate is figured at 5 per cent on $40,000,000 for the entire year and on assets of every character. This profit of $1,270,000 is available for the retirement of debt and represents the increased equity of the City in the system. This is certainly a substantial conformance with the charter requirement that the plant be acquired eventually out of earnings. The creation of a depreciation reserve which would actually indicate the lessening value of assets through wear and tear would in no way affect the amount of cash available for the retirement of debt, which requirements are in excess of $2,000,000.

Service Statistics

Service is not so easily appraised, being subject to as many a priori judgments as there are car riders. In a statistical way, however, it is worth while to note that in May, 1922, there were 1,530 cars in operation with an average monthly mileage of 3,500,000. One year later there were 1,616 cars in operation with an average monthly mileage of 4,271,000. The increase in total number of passengers was from 36,700,000 to 41,700,000. Approximately 500 of the City's cars were new, among them being 175 of the Peter Witt type.

Correlative to service is the subject of maintenance. It has been charged that the department of street railways has spent an inadequate sum on the maintenance of way, overhead and equipment. What constitutes adequate maintenance is too disputatious a subject for consideration here. It must be borne in mind that Detroit purchased so depreciated a system that it was freely predicted that uninterrupted service could not be continued. In June, 1922, one car broke down for every 2,000 car miles operated and trolley breaks totaled nearly 300 for one month, and for an average of five months were never less than 200 per month. In April, 1923, break-down of cars had been reduced to one for every 5,000 car miles operated and trolley wire breaks reduced to about 90 per month. This latter is the result of stringing 60 new miles of copper and repairing and replacing about one-third of the entire system.

Street paving continues in bad repair. The D. U. R. over a period of three years immediately prior to acquisition by Detroit, spent an average of $185,000 a year on paving over an urban and interurban system totaling 800 miles. In approximately one year the city of Detroit has spent in excess of $200,000 on an urban system of 373½ miles. It is estimated that the rehabilitation of the City's lines and equipment will cost between $5,000,000 and $6,000,000. Such rehabilitation might properly be charged to capital. Since capital is not available, it must be done from earnings, which means that the criticism of tracks and pavements in bad repair will continue for some years to come. Obviously, the system cannot accomplish a complete rehabilitation in one year. Nor can service be largely improved until some satisfactory plan of rerouting or underground dips is established. At present 18 of the 27 car lines center at the city hall, and during rush hours 700 cars per hour pass this point. There is a physical limit to the number of cars that can be operated on a given piece of track during a given time, no matter what the demand for service may be.

The Detroit Bureau of Governmental Research has just concluded a study of the finances of the department of street railways for the period of 11½ months that has elapsed since May 15, 1922, the date of the unification of the system. This report endeavors to deal in an unbiased way with the actual financial facts as indicated by the records of the department of street railways. Copies will be sent to any who may be interested, upon request, and such readers may draw their own conclusions as to whether or not municipal ownership in Detroit has been a success.

Detroit Should Succeed

From the writer's point of view, however, there is no particular reason why municipal ownership should not be a success in this instance. The plant was bought at probably only a part of its true

value and the outstanding debt against it is presumably very much less than would be the liabilities of a private corporation. The system, at least for the present, is free from politics; has had available a certain amount of capital for improvements; has operated during a year of unusual prosperity and has had competent direction, many of the operating heads having held similar positions with the private corporation. On the other hand, there is no particular reason for believing that private ownership, under similar conditions, would not have done as well. Unhappily, there is a feeling abroad in the land that the results of municipal ownership in Detroit are going to affect vividly the municipal ownership of utilities in many municipalities and have a bearing upon the nationalization of steam railroads. In consequence, the critics of governmental ownership have ascribed all sorts of derelictions to the Detroit experiment and the friends of municipal ownership have discovered untold virtues. Success for one year in Detroit does not insure permanent success, or insure similar results for other cities.

The Detroit Bureau of Governmental Research has made just one general conclusion from its examination of the complex financial problem confronting the department of street railways and that is that under the circumstances, creditable progress has been made. Aside from this one conclusion the Bureau has presented only facts, believing with James Madison, "That a popular government without popular information or a means of acquiring it, is but a prologue to a farce or a tragedy."

SELECTION OF TYPES OF ASPHALT PAVEMENTS WITH REFERENCE TO LOCAL MATERIALS

By Roy M. Green, Manager, Western Laboratories, Lincoln, Nebraska.

Importance of Street Pavement Problem

During the year 1921 over $120,000,000 was expended for the improvement of the streets in the 252 largest cities in the United States. During the same year the sum of $34,742,791 was expended for sanitation and the promotion of cleanliness, and $55,396,376 for schools in the same cities.

Over 39 per cent of all the outlay of funds in these cities was expended for highway improvement. More than twice as much was spent for street improvement as for schools and nearly four times as much for street improvement as for sanitation. These statistics indicate the relative magnitude of the street paving problem as compared with other municipal undertakings on the basis of financial importance.

Regardless of the manifest importance of this problem in every city in the United States we still find the laymen of the various cities, through their city councils, or commissions, feel justified in taking from the hands of their engineers the important problem of the selection of the type of pavement to be used in any location. The success of the street system, as a transportation medium, is entirely dependent upon this selection, yet many members of city councils feel themselves qualified to select the type of pavement to be used. These same men would hesitate to even make a recommendation regarding the design of a sewer or water-supply system, where much less money is involved in the enterprise.

Authority of Engineer

Although it is manifestly a fact that this authority should be vested in the engineer we are still confronted with the condition, in many states, where the law delegates this authority to the city council, or even worse, to the abutting property owners within the district to be paved. Without any question, this reacts against the best interests of the public and results in improper selections in many instances, and is one of the greatest contributing causes of the short average life of pavements.

Since the engineer does not have this authority it would seem, at first thought, that a discussion of the selection of types of asphalt pavements with reference to local materials is a waste of time at a meeting of engineers, but this is not true.

Even though the engineer is confronted with this condition he still has great authority in making the selection of type through the fact that he still has practically unlimited authority in the drafting of the specifications for the work contemplated. Let us call this, selection of type by specifications. Unfortunately the engineer too often overlooks the fact that he has this authority and hastily draws up his specifications by simply adopting the standard specifications of one of the national agencies that have adopted such standards, never realizing that his client may suffer great financial loss through such procedure.

There is never a locality where one of the asphalt pavement types does not have a superior economic advantage over all other asphalt types on account of the availability of some source, or sources, of supply of local materials. In some cases these local materials may be of such a nature that they will not meet the requirements of the specifications of the American Society for Municipal Improvements or of the Asphalt Association. I do not wish to be understood, however, as criticising these specifications, because I most heartily approve of them, and especially those of the Asphalt Association, which I consider as the best group of standard specifications that have ever been prepared, but I do wish to bring out the fact that the blind use of standard specifications is poor engineering and results, in many cases, in higher costs to the owner without a corresponding improvement in the quality of the finished product. On the other hand, it is likewise very poor engineering to specify for the use of local materials without first making a very thorough investigation of these materials. Furthermore, such an investigation should not simply include the usual laboratory tests of these materials but should embrace a thorough examination of the deposits, method of production, quantity and uniformity as well as quality of the material itself. These investigations should be carried on only by persons who are thoroughly qualified, through years of experience in the construction of asphalt pavements, for if they are not, the entire expenditure of the owners' money is then being placed upon an experimental basis, which is a condition never justifiable under any circumstances.

If this procedure is followed it will be possible for the engineer to exercise great influence in the selection of type with reference to local materials if he makes a thorough investigation of the availability of materials of all kinds and then makes sure to include in his specifications a description of the type that can be constructed by using the greatest quantity of low priced material of a quality that is entirely satisfactory for the purpose intended. As soon as bids are received under these specifications the price bid on this type should be low enough to make the selection almost inevitable.

Abuse of Selection by Specification

Allow me to take two illustrations from cases that have come to my attention in our practice. In one city an engineer asked for bids upon sheet asphalt and asphaltic concrete, coarse aggregate type. The specifications for the large aggregate for the asphaltic concrete allowed the use of a very inferior grade of broken stone and as a result an aggregate was used having a toughness of only four when treated by the Page Impact Machine. To have obtained satisfactory large aggregate of broken stone for this work would have required its being shipped for a distance of over 500 miles and from another state at a very high freight rate.

On the other hand the large aggregate for use in the binder course of the sheet asphalt was described in such a way that it required an aggregate of a toughness of 10 and a French coefficient of wear of not less than eight and made it necessary to ship this material a distance of over 500 miles, while there were good commercial deposits of gravel containing materials that would have been entirely satisfactory for that purpose within a distance of less than 50 miles. All other aggregates entering into the construction of the sheet asphalt pavement were even nearer than this with the exception of the stone dust for filler. The engineer either abused the privilege of selection by specifications and deceived the owners' confidence and wasted their money or he was ignorant. In this case, I believe that it was the former, because he specified also that the binder for the sheet asphalt should contain 7 per cent of limestone dust. The city is no longer a client of the engineer.

Proper Use of Selection by Specification

Let us consider another illustration, where specifications were drawn with the intention of utilizing available materials to the greatest advantage. The city, through their engineer, adopted a specification, which incidentally is not in accordance with any of the standard specifications for large aggregate for binder construction, but is good practice and has been demonstrated as being satisfactory for the work contemplated. Through the use of these specifications, instead of the adoption of one of the standard specifications, the most economical selection was apparent to any unprejudiced party and resulted in the saving of approximately $50,000 on a two-year paving program and the quality of the work did not suffer in the least

detail. All the aggregates for this work were obtained within 5 miles of the improvement with the exception of the limestone filler.

In closing, however, I wish again to sound a word of warning against the adoption of any local materials or special specifications unless their adoption is thoroughly investigated by one who is unquestionably qualified to pass judgment upon their utilization for the work contemplated as it would be a serious error in policy to place the expenditure of public money, in such great quantities, upon an experimental basis and it would react against the best interests of all concerned in the construction of roads and pavements. I wish to draw attention to the economic value of making thorough investigations of all sources of supply of materials for utilization in the construction of asphalt pavements.

The foregoing paper was read by Mr. Green at the recent Asphalt Convention held in Denver, Colo.

REGULATING THE PARKING OF AUTOMOBILES

By John Ihlder, Manager, Civic Development Department, Chamber of Commerce of the U. S., Washington, D. C.

A few years ago automobile salesmen talked about the saturation point in terms of the public's buying power. They calculated the possible number of automobiles in a state by the number of families with a certain income. Today such figures, except as applies to the rural population, are going into the discard. The saturation point for automobiles is coming to be the incapacity of streets, not only in cities, but even in towns and villages, to hold more cars.

Experiments With Moving Traffic

A year ago we talked of regulation in terms of moving traffic. The traffic cop had become a familiar sight even to the most untraveled American. We exercised our ingenuity to devise methods of expediting traffic by rules and signals and no left turns and one-way streets. We even devised high towers which would halt the moving lines of cars for blocks when the light switched from green to red. Then the law of diminishing returns got in its deadly work and we today see the long lines halted on a busy main traffic artery blocks away from the signal tower when there are no vehicles waiting on the little-used cross street. Then we tried speeding up the traffic, and, turning our animosity from the fast driver, leveled our imprecations at the cautious one who slowed up the line, until actual count showed us that increasing the speed beyond a certain limit means no more cars passing a given point in a given time than does a slower movement—for the simple reason that each driver leaves a little more space between his car and that in front.

What to Do With the Standing Car?

Now we have suddenly awakened to the fact that this interesting game of regulating moving traffic, while the more dramatic, is not the more important part of our problem after all. The more important part is to find out what to do with automobiles, not when they are moving, but when they are standing still Until some inventive genius invents a collapsible car that can be folded up and put into the hall closet or a corner of the office, this question of what to do with an automobile when it is not in use is going to cause more and more concern to manufacturers and salesmen and to would-be owners, than ever has been caused by justices of the peace with a keen eye for local revenues.

Some Abandon Driving to Work

Of course we have been making tentative and superficial efforts to answer this question for some time, but with results so unsatisfactory that in the largest cities car owners have given up the attempt to drive to their offices near the center, and even in moderate sized towns the merchants, the police and the car-owning public are most dissatisfied with these results and with each other. Curtailment of parking privileges along business streets to periods limited from a brief stop to discharge passengers to a two-hour stay, unless supplemented by constructive measures, are only expedients which give some relief at considerable cost and annoyance.

Is the Automobile a Nuisance?

So recent is our realization of this problem that there are regulatory authorities who still approach it from the point of view that the automobile owner is more or less of a nuisance who should be thankful for whatever facilities are grudingly granted him, and some traffic experts who maintain that inasmuch as two or three riders in an automobile take up more space in a city street than do several times that number in trolley

cars or subway trains, therefore the answer is to limit more and more strictly the use of automobiles in downtown areas, perhaps confining it to taxi-cabs which, being more constantly in use, serve a greater number of passengers and call for only a fraction of the parking space.

Effects of Rapid Rail Transit Cited

Of course such a solution as this is no solution, but is rather a method of intensifying conditions that make for further overcrowding of our already overcrowded business and apartment house areas. The result would be the same as that which followed the building of elevated railroads in New York and Chicago and later that of subways in New York. Both were acclaimed as means of spreading out the population, for was it not obvious that workers in downtown districts could by these means afford to live farther out? Of course what followed was the exact reverse; those who lived farther out did more business downtown and conditions instead of being bettered became much worse. Not only did business buildings increase in size to accommodate the new hordes of workers, but high apartment and tenement houses with constantly smaller and fewer rooms per apartment closely encircled the business districts because a large proportion of the workers found that the time, expense and discomfort of twice daily journeys by rapid transit were such a handicap that uncomfortable housing seemed to them the lesser of two evils. The way out is *not* by devising methods of compressing human beings into smaller compass, but by devising means of living and doing business comfortably and economically.

The Present and Future Problems

When one comes to study the problem from this point of view he finds that it divides itself into two parts: First, the immediate problem of what to do now under existing conditions to get the utmost practical value out of the automobile with the least possible cost and inconvenience to the community; second, how to guide the future development of our cities and towns so that this modern means of transit may be more and more generally used to the increasing benefit of all the community.

What the Shriners Taught Washington, D. C.

There still remains in some quarters the belief that the passenger automobile is primarily a pleasure vehicle. Even if it were, there is a strong argument for facilitating its use. But we had a recent demonstration in Washington of the falsity of this notion, at least so far as concerns their parking on business streets. We have had the Shriners with us. During the days of their visit they nearly doubled the population of the City. Prophecies were that they would bring with them at least 30,000 automobiles. We were impressed by the probable difficulties of handling so large a number of visitors and in order to make space for them our rulers—you know that we who live in the District of Columbia are not citizens except by courtesy, for we have no vote and no voice in our government—our rulers, the District Commissioners, decided to put a ban on parked automobiles in the central business district and fortunately decided to put this ban into effect a week before the Shriners' convention opened. I say "fortunately," for this edict gave us a fact which otherwise would have remained a theory. On the day the ban went into effect the downtown stores were empty of customers. The long aisles between heaped up counters were deserted. Trolley cars operated as usual and to capacity. But the automobile shoppers, chiefly the drivers of the cheaper cars who do not support chauffeurs, were absent, and their absence made so startling an effect that by noon a hastily assembled committee waited upon the commissioners and successfully petitioned that the ban be lifted. The automobile has become a necessity of modern life and our task is to devise methods of utilizing it, not to follow an ostrich-like policy of ignoring its value.

The Motor Vehicle a Modern Necessity

The means immediately available for dealing with the standing automobile are limited and, as indicated before, are largely in the nature of more or less unsatisfactory expedients. The first requisite is to approach the problem from the point of view that the automobile, passenger car as well as delivery truck, is a necessity of modern life and that our purpose is to facilitate its use. The degree in which various expedients may be used will vary in different cities and towns according to local conditions. There are, however, some generalizations which may be used as guides. First, the streets are designed primarily for transit. Consequently they must be

kept free from standing vehicles to the extent necessary for an even, uninterrupted flow of traffic. Second, the entrances to hotels, office buildings, large stores and other buildings in which there is a great amount of coming and going must be kept accessible. Third, so far as is consistent with the foregoing, car owners should be permitted to park their cars on the public streets or other public space in front of or close to their destination and leave the cars there all day if they so desire.

The third generalization is, of course, an ideal and as with ideals can be only more or less approximated. Even in small country towns there are periods, as on Saturday evenings during warm weather, when the whole area of Main street in the business section will not accommodate the cars of all the farmers who come in to town. Consequently an effort must be made to provide convenient supplementary parking space. But no other space will be more than a second choice substitute for the curb in the middle of the principal business block where the car owner and his wife not only have the shortest carry from store door to car and can have their children constantly in sight, but where, when seated in their car, they feel almost a part of the holiday crowd from which they can call out passing acquaintances and hold a series of informal receptions. In larger towns and cities only a fraction of those who wish it can secure this ideal parking. But that is no reason why those who come first should not be served first so long as this does not interfere with traffic or access to much-frequented buildings.

Time Limit Expedients

Between this all-day parking and the stop to discharge passengers before a hotel, there are gradations in time limits, the value of which is still largely theoretical. Whether a 15-minute parking limit is, as a rule, of practical use, may be questioned. For the man who reads your gas meter this would be ample. Perhaps it should suffice for the life insurance agent. But it is not enough for the woman who is buying material for a new set of curtains or for the family dinner. Perhaps we shall come to a simple threefold classification of parking spaces on business streets; stop to discharge passengers, shopping stops which may extend from 15 minutes to two hours, and all-day parking.

But with all the time limit expedients we can devise our streets in the business districts and in many apartment house districts are now inadequate to contain all the cars whose owners wish to park them there. Supplementary parking space must be provided.

Using Vacant and Idle Spaces

In towns and cities where there are considerable areas near the business section—but not with valuable business frontage—still unbuilt upon, the municipality should acquire these and maintain them for automobile parking. It may charge car owners a small fee for this service on the principle that it charges users of city water, or it may give the accommodation free on the principle that it permits free use of the sewers, to take care of what might otherwise become a public nuisance such, for example, as the "cruising" of automobiles, including taxi-cabs which have no parking space.

In nearly all cities, large as well as small, there are considerable areas in the centers of blocks, even in downtown districts, now disused or wastefully and uneconomically used. So long as these block centers remain in private ownership they are a constant temptation to the erection of deep, solid buildings, the lighting and ventilation of which is difficult and expensive. There is an economical height for a store or office building. Where blocks or squares are so large that this economical depth is exceeded, the rear ends of the lots may well be thrown into one open space and used for parking. Incidentally such a use, meeting a real need, would greatly lighten the task of those called upon to enforce those sections of a building code requiring light and ventilation, and it would maintain the rental value of rear offices which would no longer be shut in by the solid walls of a neighboring structure.

Field for Private Enterprise

But as this phase of municipal service is likely to be slow in developing—though Chicago, for example, is already using part of Grant Park along Michigan Boulevard for parking, Cleveland and Detroit are more or less systematically utilizing open spaces, Brockton, Mass., has created an open space in the business district for this purpose, etc.—and never will meet fully the demand in the present centers of existing cities, there is a large field for private enter-

prise which would cater to those owners who have the means to pay for service, who wish their cars protected from storm and sun when not in use, who need mechanical assistance or who just feel more comfortable when their cars are safe from thieves.

To meet this demand a number of methods are now being tried out, ranging all the way from storage buildings several stories in height, equipped with ramps or automobile elevators, to the use of basements or cellars reached by ramps. Private initiative also has seized upon vacant lots and in some cases the back yards of business blocks, and is using these temporarily for automobile parks. What private initiative has here begun, indicates what municipal service can more adequately and systematically do. One rule to use as a guide here is that all such storage or parking spaces should have their entrances and exits—and they should have separate entrance and exit—on side streets or minor streets, where the constant crossing of sidewalks by automobiles will least interfere with pedestrians.

But so far as we now know, the use of all these methods to the utmost practicable extent will not meet the demand. Washington, which has a larger proportion of its downtown area given up to streets than any other city, which has many downtown streets so wide that cars can be parked at an angle on both curbs, seems to find the parking problem as difficult as other cities. The reason apparently is that the greater parking area results in a greater use of automobiles. It is the antithesis of New York City, where, in lower Manhattan, the very limited parking space almost prevents the use of private cars. That is, the greater parking space puts off the saturation point and thereby benefits the community.

Parking Motor Trucks

So far I have had in mind the passenger automobile, not the truck. The latter presents problems peculiar to itself. Except for the small retail delivery truck, its size alone makes difficulty. If parked parallel to the curb, it takes up a large amount of space and is placed inconveniently for loading and unloading. If parked at an angle it projects so far into the roadway and often so far over the sidewalk as to be a very real impediment to traffic.

Interior Versus Sidewalk Loading

In these days, when we are studying economies in the transportation of goods, we hear a great deal about store door delivery. This conjures up a picture of trucks running regular routes from railroad freight yards to the front doors of stores in the business section, backing up to those doors and unloading on the sidewalk. While this picture portrays quite accurately what does occur in some of our cities—witness the numbered streets on the west side of Manhattan Island—it certainly does not portray a workable system for the future. Loading and unloading of merchandise in quantity for business establishments must be done on spaces devoted primarily to that purpose and preferably on the private property of the business establishment.

It may be that New York, with its small blocks, and some of our other cities where construction has already filled the space behind building lines with structures which can be remodeled only at great expense, will have to compromise by setting aside certain minor streets for this purpose. But the way of the future would seem to be a requirement that the firm which constantly loads and unloads trucks shall do this work in a yard or a first story designed for the purpose and on its own property. Zoning will simplify this problem somewhat by tending to segregate establishments which require such service and so prevent their blocking thoroughfares used by the general public. But zoning is not by any means a complete answer, for department stores and many wholesale establishments will and should remain in and near the business centers, fronting on streets which carry great volumes of traffic.

Automobile May Reduce Crowding of People

In towns and smaller cities with their problems of size still in the future, in the still spacious suburbs of big cities, where city planning has today a fairly free field, there is opportunity to provide for future needs. The fundamental evil in our urban centers is the crowding of people too close together. The essential point to bear in mind in our new developments is the value of adequate open spaces. To create great parks and well equipped playgrounds as means of relief for those living huddled together in barrack tenements or packed into suffocat-

ing subways is but to give a mild antidote after administering a dose of poison. Human beings need space if they are to live and develop properly. Even in the congested downtown areas of our old cities the automobile may have some effect in thinning the population simply by occupying buildings or parts of buildings that otherwise would shelter swarming masses of people. In the suburbs and in the smaller cities they may prevent congestion by reason of the space they occupy.

The Little Business Center in the Big Town

We have long been familiar with the fact, though we have not always used that fact as a basis for reasoning, that a city normally grows by establishing a new little business center. We have interfered with this normal growth by some of our modern devices—for example, the retail business center of Jersey City was almost wiped out by the Hudson tubes—but in spite of us it continues to be normal. As with most normal things, there are very sound, wholesome reasons for this. One of them is that people wish to have their business places within walking distance of their homes. Another is that in the transactions of daily life most of us like to have human relationships. The housewife likes to know her butcher and to be known by him. As we grow snobbish we may change our objective to the head waiter of the Waldorf-Astoria or the proprietor of a lobster palace. But it is the same old craving.

Much Expected of City Planning and Zoning

. Because city planning and its more popular twin, zoning, fit in with this craving for neighborliness, for knowing and being known, they are becoming an accepted part of city building. With them as our instruments we shall be able, among other achievements, to provide adequately for the storage and parking of automobiles in the as yet undeveloped urban areas.

Some months ago I spoke before the Business Men's Association of a thriving little business district in Washington. It has a branch bank, a large moving picture theater, grocery stores, butcher shops, dry goods store—all the necessary magnets for a family's income. I talked automobile parking space. The business men admitted that a large part of their trade, even though it seemed a neighborhood trade, came by automobile. They admitted that it would not be much exertion for their customers to drive two miles farther to downtown stores with larger assortments of goods. They accepted, though reluctantly, the theory that one reason their customers did not drive down town was the difficulty of finding parking space there. They admitted that parking space on their own streets was becoming scarce. But they halted at the novel suggestion that now is the time for them to get and hold as an automobile park, some vacant land in the neighborhood. That meant money. It meant a vision of the future. The effect of the Shriners' ban may convince them. But if not they, then the business men of some other center a mile or two farther out will make practical application of the lesson of experience. To provide space for automobile parking is good business.

Parking in Residence Districts

In my suggestions I have emphasized the importance of the automobile to business, and have done this for two reasons: First, because many of us are still inclined to regard the automobile as a pleasure vehicle except when it is in the obviously business form of a delivery truck; second, because our cities exist because of business. If it were not for business there would be no cities, no means of paying taxes, no pay envelopes from which to extract the wherewithal for rent and food and clothes—and automobiles. So it is necessary to consider the automobile as a facilitator of business. But business is not an end in itself, it is simply a means to an end. Its purpose is to enable us to live more abundantly. Consequently we can not stop with the automobile in the business district, but must follow it home to the residence district. Here, in areas where apartment houses have multiplied, we find almost as acute a situation as we do down town. Parked automobiles line the curbs in solid rows, and still there is not space enough.

In residence districts there are at least two considerations which make the situation different from that in business districts. Nearly all the differences over which men become excited are not differences of kind, but simply differences of degree, differences of emphasis. Here is such a difference. A business street, the frontage of a business block, is much more a community property

than is a residence street, the frontage of a residence block. A citizen or a tourist may have a perfect right, based upon the general good, to park his car in front of your store and leave it there, while he may have no such right to park and leave it in front of your house.

If only an occasional stranger parks his car before your house and does it only on occasional days, the annoyance is so slight that you will probably pay no attention to it. But if the curb in front of your house is constantly occupied by the cars of strangers so that you can not drive up to your own front door and so that your visitors have to leave their cars at a distance; if the starting of motors and the smell of gas constantly wreck your quiet and peace of mind, you have legitimate cause for complaint.

Here, then, is the basis for another generalization to use as a guide, that in residence districts cars may be parked along the curb only in front of the residences of their owners or the residences of those upon whom their owners are calling. This is a rule to be often honored in the breach and it is necessitated chiefly by the abuse which follows the intrusion of large apartment houses into districts of one-family homes. These apartment houses now derive a large part of their attractiveness from the fact of their being surrounded by homes, and in return they are usually a decided detriment to the homes upon which they sponge. They should not be permitted to add to the damage they cause by lining the streets far beyond their own frontages with the cars of their occupants. The cars of one large apartment house can quickly depreciate the value of residence property for a considerable distance.

The second consideration which differentiates business district parking from residence district parking, is that in the former parking is nearly always only a day-time affair, or, near theaters, an evening affair, while in residence districts, especially in these times of high building costs, it tends to become an all-night affair. While admitting the practical difficulties faced by the car owner due to building costs, it should be the rule that all-night parking of cars on public streets be forbidden. The owner may not be able to build a garage now, but he should at least drive his car onto his own lot. If he lives in a row house erected upon a lot so small that it contains no space for a car, or if he lives in an apartment house which provides no storage facilities for its tenants, then he is under the necessity of renting garage space somewhere else.

The reasons for this distinction as between business districts and residence districts are fairly obvious. A parked car at night, especially on a dimly lighted residence street, is a hazard to moving vehicles even if its parking lights are kept lighted. A car at night, especially in residence streets, presents more difficult police problems; it is a shelter for clandestine doings; it presents greater opportunity for thieves. Moreover, the requirement that there be provided space on private property for the night storage or parking of automobiles is in line with the sound policy that our people should have adequate space in which to live and grow and move.

Some Remedies of Doubtful Value

You will have noted that in this discussion there is no suggestion for automobile subways or for double-decked streets or for sidewalks raised a story above the roadway. All of these have been suggested in more than one city and in New York such suggestions have assumed very definite form. My belief is that automobile subways would be not only ruinously expensive but that they would be community liabilities in other ways. Double-decked streets might cost less to construct, but they would be quite as injurious to those who must use the close lower level. An argument may be made for such construction if it is of small extent and undertaken in connection with other improvements, as on South Water Street in Chicago, but this is exceptional. Raised sidewalks would provide a great amount of parking space beneath but, even assuming that they can be hung on brackets or supported in some other way not necessitating posts or pillars which create a hazard for traffic, they, with the required bridges across intersecting streets, would shadow and darken the roadways and parking spaces below.

Our modern means of transit, including the automobile, make it possible for us to spread out our population instead of herding it in compact masses. In the past we have talked distribution, but have practiced concentration. Now let us practice what we preach. There is

plenty of land available in America, our chief handicap in utilizing it is our blind following of habits acquired when we had to do all our traveling on our own two feet, or at best on the four feet of a horse. Open air and sunshine are the greatest agents for human health and happiness. They are to be had in inexhaustible quantities, but we have perversely exercised our ingenuity to deprive ourselves of them and then furnish artificial substitutes at great cost.

By proper city building, by intelligent grouping of industries, commerce and dwellings, we can reduce real distances, i. e., the distances each individual must traverse in his daily routine, to a fraction of what they now are in our largest cities. By limiting the proportion of an area that may be built upon and by limiting the height of buildings we shall prevent any duplications of the lower end of Manhattan or the loop district of Chicago or the center of Los Angeles. Then the more economical, more wholesome, more cheerful open street will serve our needs adequately and cause us to regard with pity the inhabitants of those cities whose past mistakes force them to live the lives of ground hogs burrowing their way through subways and under double-decked streets from apartments whose windows never catch the sun to gloomy offices whose chief illumination is furnished by the kilowat hour.

A generous provision of open streets will prove far less expensive to construct and maintain than would such underground passageways. As a basis for determining what is adequate I would suggest:

On main streets in retail districts the roadway should be wide enough for a line of cars on each side, parked at an angle of 45 degrees, for a line of traffic in each direction and for two trolley car lines. In this case the parked automobiles would be along the curbs. If the street is enough wider to permit two lines of traffic on each side, so that the stopping of an automobile for a moment would not halt traffic, the parked automobiles may be put near the center of the street flanking the trolley car tracks, so leaving the curbs available for discharge of passengers. This also has the advantage of preventing automobiles from using the traction right-of-way and so impeding trolley service. Otherwise it is necessary to keep the traction right-of-way available for automobile traffic, which will occasionally have to circle about a stalled car.

On secondary business streets the width should permit of two lines of cars parked parallel with the curb, though parallel parking is not so good as parking at an angle.

In apartment house districts streets should be wide enough for parking at an angle.

In one-family house districts there should be no need of providing for continuous lines of parked cars. Unnecesrary width of roadway means unnecessary cost for the home. It is cheaper to park one's car in the yard.

The foregoing paper by Mr. Ihlder was read at the recent annual meeting of the New York State Conference of Mayors and Other City Officials.

REVISION OF BAD LAW STIMULATES MUNICIPAL IMPROVEMENT WORK IN MISSOURI

By F. H. Frauens, of W. B. Rollins & Co., 521 Railway Exchange Bldg., Kansas City, Mo.

The recent activity of a number of Missouri cities in the construction of sanitary sewer systems brings to mind the stimulating effect that the correcting of inequitable laws may have on public improvement work.

Up until a few years ago, Missouri cities of the third and fourth class could vote bonds for public improvements in an amount of not to exceed 5 per cent of the assessed valuation, which meant that after bonds had been voted for water or light plants, there was usually no margin left for sewer systems, especially since it was the general practice to make assessments of property much below the actual value.

This left only one way open for the construction of sewer systems; that is, by the issuance of tax bills. By this method the work was constructed by order of the City Board, and special tax bills issued against the property benefited. This method was unsatisfactory for two principal reasons; first, because the tax bills could run for not to exceed three years, bearing interest at 8 per cent, and second, because the assessment was made on the square foot basis. Another reason was that since the law stated that the tax bills must be turned over to the contractor in payment for his work, it was

necessary that they be discounted from 15 to 25 per cent in most cases. The result was that movements for the construction of sewers in a large number of good, prosperous towns met these objections and the improvement was not made.

About two years ago, however, an amendment was passed which allowed the issuance of bonds for water, light and ice plants in an amount of 10 per cent of the assessed valuation additional, which thus left the original 5 per cent available for sanitary sewer systems.

During the year of 1923 quite a number of bond issues for sewerage purposes have carried, some of them being in towns where this improvement had been continually agitated without success before. Probably the first city to put the proposition through was Harrisonville, population 2,100, where a $60,000 bond issue for a complete sanitary sewer system carried in December, 1922, by a 10 to 1 vote. The proposition had been considered and turned down a number of times in the past six or seven years when it was proposed to issue tax bills in payment, and the large majority by which the bond issue carried is a good indication of the advantages and popularity of the bond method. Since this issue was put over, the following towns, all in Missouri, have voted bonds for complete sanitary sewer systems and for the water works improvements necessary to furnish water for the operation of same:

Salisbury, population 1,800, bond issue $50,000; Chamois, population, 700, bond issue $30,000; Edina, population 1,500, bond issue $120,000; Canton, population 2,400, bond issue $80,000, and Unionville, population 2,200, bond issue $80,000. In addition to these, elections were held in September at Greenfield, population 1,500, amount of proposed issue $60,000, and Kahoka, population 2,500, amount $75,000. These are only projects on which the firm of engineers of which the writer is a member has been engaged, and in addition there have been several similar jobs handled by other firms.

Since there has been no marked period of prosperity or awakening of public spirit this year in Missouri, nor is there any other possible reason for this activity in the construction of sanitary sewerage systems except the change in the Missouri law mentioned above, it is reasonable to assume that it was the fact that it was possible to install sewer systems on an equitable basis that was responsible for the change, and hence the general conclusion may be drawn that municipal improvements of all kinds are strongly influenced by the kind of laws under which they may be secured.

SOME PRESENT ASPECTS OF PUBLIC UTILITY APPRAISALS

By Edward W. Bemis, Consulting Engineer, 139 N. Clark St., Chicago, Ill.

Except for an occasional appraisal of a water works plant for municipal purchase, there was no appraisal worth mentioning of any public utility or steam railroad in America, or probably in Canada, prior to 1900 and very little prior to the New York City Consolidated Gas case before the Federal Court in 1906. There were a few gas appraisals before the courts soon afterwards, as in Cedar Rapids and Saginaw. Appraisals on any large scale, or pursued in any scientific manner, virtually started with the beginning of state commission regulation in New York, Wisconsin and New Jersey in 1907, followed by other states in rapid succession and by the Interstate Commerce Commission in 1913. Massachusetts, to be sure, had been regulating her gas and electric light utilities through a State Commission since 1884, but had based that regulation on the book records and reports to the Commission as to actual investment, without such check as to depreciation as would have resulted from a careful appraisal.

Why Appraisals Are Made

Appraisals of properties of much size, outside of water works, have been mostly for purposes of rate regulation. Some have been made for purposes of security issued and some (mostly small water and electric plants) for purposes of public purchase. The number of appraisals for public regulation seems likely to decrease because appraisals once made are often brought up to date by taking account of property added and retired and perhaps by some arbitrary percentage added to the old appraisal to represent estimated changes in unit prices. Appraisals for public purchase are likely to increase with the growth of the public ownership movement.

Public Side of the Question Neglected

It is exceedingly unfortunate that, whereas the utilities recognize the importance of appraisals for every purpose, our cities and the public at large do not realize the vital importance of these ap-

praisals, whether for the issuance of securities, the regulation of rates or for public purchase. The consequence is that the public side of valuation work is not as carefully and fully presented to courts and commissions as is the company's side.

One important reason why, for example, many utility decisions lean more to reproduction cost at present prices than to original cost or actual investment, is because the companies—following their immediate self-interest—have presented present reproduction cost with no end of thorough preparation and careful detail, while the public have gone to sleep and have left their attorneys that often hold public office only for short periods of time, to fight out these matters without any adequate engineering, accounting or other help.

What Happened at Seattle

Seattle's grave difficulties with her street railways arose from the purchase of the property without any appraisal and naturally, under those circumstances, at a very high valuation. In the case of public purchase, it ought by this time to be recognized that an appraisal, with full regard to existing depreciation from obsolescence and inadequacy, and from the growth of public demands for the burial of wires, improved foundations for rails, etc., is fundamental.

The Case of Public Purchase

What isn't so clearly understood—and indeed among friends of public ownership is hardly understood at all—is that appraisals for rate regulation or for the issuance of securities are also vital, not only in their bearing upon the purposes of such appraisals, but upon the purchase price in case municipal ownership is sought. A valuation once fixed for any purpose, whether for taxation, regulation or issuance of securities, is likely to have great weight with a commission or court in a later valuation for public purchase. Furthermore, and this must not be ignored, the profits obtained under rates fixed by a commission or court on the basis of an appraisal for rate regulation will largely affect values in case of public purchase. In the latter instance much weight is given not only to appraisals at present prices, but to the capitalization of present and prospective earnings under the system of regulation in vogue.

For example, if a commission allows a 7 per cent return on $2,000,000, on the theory that that is the cost of reproduction less depreciation, or $140,000 a year, instead of allowing 7 per cent on $1,000,000 or $70,000 a year, in cases where the $1,000,000 represents the original cost less depreciation of the property now in use, the result in case of public purchase is marked. A utility earning $140,000 a year might easily be capitalized in public purchase on a 6 per cent basis, i. e., for over $2,300,000, whereas if it were earning only $70,000 a year on the same physical property, actually costing the same as in the previous case and equally depreciated, the price in case of sale might easily be only half as much as in the other case.

Disagreements on Elements of Value

It is, of course, not assumed or contended that any appraisal for any purpose should be lower than what our highest courts consider fair and equitable, but there is such a divergence of opinion even in our Supreme Court in different cases as to the relative weight to be given to various elements of value, that a strong presentation by any public body of such an element of value as original cost less depreciation, or of the actual investment in the property by stockholders and bondholders, accompanied by the record of its past earnings and their disposition, is bound to have a great influence in determining the rate base and consequently in determining the earnings thereon, and therefore the purchase base whenever that becomes a practical issue.

The Decisions of This Year

The three valuation decisions of the U. S. Supreme Court in the Missouri Bell, the Bluefield and the Georgia Power cases this year indicate that however much some of the justices lean toward present reproduction cost, the court is not likely to upset any commission decision which allows for the present value of the land and either the original cost less depreciation of the property now in use or the reproduction cost on pre-war prices of the property in use at the beginning of the war plus subsequent additions at cost, provided a return of 6 or 7 per cent on this valuation is granted.

When utilities present elaborate appraisals and, based thereon, seek official approval for the issuance of new securities on top of those already out, which may be to a considerable extent water, cities often so little appreciate the situation as to make no critical examination of the companies' appraisal. The cities sometimes are not even represented at

such a hearing, yet the valuation then fixed and the securities then allowed may greatly affect any subsequent decision of court or commission with respect to rates or purchase.

Only a Beginning Made

Only a beginning, however, has been made when the importance of an appraisal is recognized. Appraisals will be a snare and a delusion unless our elective bodies of our governors and presidents, as the case may be, put upon our commissions and courts, and unless our cities select as their appraisers men who have the public point of view instead of those who, by training and habits of thought, are in sympathy with the corporation point of view, or who hope to be attorneys or engineers and appraisers for our public utilities after securing some prestige in our courts and regulative bodies. There is such a fundamental difference in the attitude of appraisers for companies and for cities or other public bodies in the treatment of depreciation, going value, the weight to be given original cost, investment, etc., that it is about as hard for an engineer or an attorney to serve with equal ability and success a company today and a city tomorrow in a rate or purchase case, as it is for the camel to go through the traditional eye of the needle. Engineers, accountants, commissioners and attorneys can agree on the physical and financial facts in a given case, but the real weight to be given these facts and the conclusions to be drawn from them in any rate or purchase case depends so largely upon one's point of view with respect to ethics, economics and public policy, that I have yet to meet a man who can equally well serve both the public and private companies in appraisal work.

What an Appraiser Must Know

In the next place, qualifications now required in appraisal work cover not merely purely engineering and accounting data. It will pay to dwell upon this a moment. The appraiser must be familiar with our highest court decisions. The average corporation counsel or attorney-general—busy with many lines of legal work—must largely depend on an appraiser's thorough knowledge of adjudicated cases affecting the question in hand. One must know how to use the books and other records of a company and direct the accounting investigation; he must understand the various theories of depreciation and how to apply depreciation consistently with respect to both annual and accrued depreciation, whether on the straight line or sinking fund theory. The appraiser must know how to determine the cost of reproduction of a property at the average prices of 1911-15 inclusive, and must be thoroughly acquainted with necessary overhead charges in both original cost and reproduction and be able to criticise the accuracy of any appraisal presented by a company. In the Georgia power decision, handed down June 11, 1923, the United States Supreme Court held that the Commission had paid sufficient attention to the present cost of reproduction when it had valued the depreciable property in existence Jan. 1, 1914, at "substantially its actual cost or its reproduction cost as of that date," together with the actual cost of subsequent additions and land at its present value. It therefore becomes desirable to set up the original cost, actual or estimated, and as an alternative proposition, the reproduction cost on pre-war prices, which are usually taken as the average of 1911-15 inclusive, plus the actual cost of subsequent additions.

Then as a basis for a going value exhibit there should come a careful study of the past profits and their relation to the yearly investment from the beginning of the company. The rates at which public utility securities are floated from month to month and year to year must be presented clearly and in detail. Even though the conclusions reached are presented as merely advisory or suggestive to a court or commission, a proper appraisal requires an able combination of engineering, economics, law and the consideration of questions of public policy on the part of the appraiser.

Railway Valuation

The greatest problem of internal policy confronting the Congress of the United States the coming winter has grown out of the refusal up to date of the Interstate Commerce Commission to obey the Railroad Valuation Act of 1913 and present to the country the original cost of the present property of the railroads and the value of the aids, gifts and grants to them in lands and cash by governmental bodies. The Commission admits that the Valuation Act can be obeyed, although it claims at a cost of perhaps $25,000,000, and merely asserts that it did not believe Congress intended any original cost or the amount of aids, gifts and grants to be set up unless found in the existing

books and records of railroad and telegraph companies. In other words, they strangely contend that no estimates must be used of original cost to supplement such records as are extant.

In comparison with the importance of the information called for by the Act, the cost of getting it, even if it should be $50,000,000, is a mere bagatelle where billions are at stake. Far more in values is involved than the price of the four million negro slaves in America in 1860 which, at $500 each for man, woman and child, would have amounted to only $2,000,000,000. Nor is this all! The Valuation Act of 1913 required the determination of reproduction cost and of original cost. If our United States Supreme Court has before it (as it will have unless something is done) only the opinion of the Interstate Commerce Commission as to reproduction cost, although on pre-war prices, there is every reason to fear that the court—having no original cost to tie to—will say that reproduction cost must logically be brought up to date by applying some percentage indicative of the increase of prices, and we shall end with a valuation so much higher than the tentative valuation used under the Esch-Cummins Act of $18,900,000,000, as very likely to exceed by $10,000,000,000 the actual cost less depreciation of the property now in use.

Nor is even this all! The ignoring of original cost by our United States Supreme Court in the absence of any evidence of original cost on our railroads, will serve as a precedent in all our city utility cases and in all our state-wide telephone cases. The margin between actual cost and reproduction cost on present prices in the case of the city utilities is as much as in the case of the railroads, or another $10,000,000,000. Our utilities and railroads are no longer afraid of the exposure of their watered stock and sometimes even watered bonds, since they have found it possible to lull the public to sleep while they pad their rate or purchase base with present reproduction cost and high going values, with ridiculously small allowances for accrued depreciation.

If our cities and other public bodies would only go to the expense of securing and properly presenting the original cost less depreciation, and other matters outlined above, and employ competent engineers committed to the public point of view, our commissions and courts would render much lower decisions as to rate and purchase bases, in most of our public utility cases, than they do now. Our cities and citizens cannot afford to leave investigations and appraisals to commissions, but must present to these bodies as carefully prepared appraisals as if before a court or, as very often happens, these commissions, which are quasi courts and poorly equipped financially for complete appraisals, will be unduly but naturally influenced by the weight of evidence submitted by companies—which frequently spend three dollars to a city's one in a rate or purchase case.

Is it not time to wake up on this question of appraisals?

The foregoing paper by Mr. Bemis was presented at the 1923 meeting of the Municipal League of Indiana.

SOME SUGGESTIONS FOR MUNICIPAL TRAFFIC RELIEF

By H. W. Slauson, M. E., Engineering Service Manager, Kelly-Springfield Tire Co., 250 W. 57th St., New York, N. Y.

I believe there is one practical suggestion which should be adopted by every city in which street congestion is serious. This relates to the traffic confusion which is so greatly aggravated by the trolley, which not only controls the speed of travel on its own track but which may also bring several parallel lines of vehicles to a complete halt every time it stops to take on or discharge passengers—and during the rush hours when automobile congestion is greatest, this trolley interference is at its maximum effectiveness.

Most of us no longer agree with the radicals that the trolley should be legislated out of existence. Heretofore it has represented a legitimate investment. It pays, when it is able, a high franchise and tax rate and is frequently compelled to keep the pavement between its rails, and for a certain distance on either side, in better condition than the city maintains its own streets. Furthermore, after a severe snow storm it is frequently only the trolley right-of-way which has been plowed, swept and made passable for other vehicles.

But, where the trolley should have the privilege of controlling only a single line of traffic, in reality, as has already been pointed out, it controls every line of traffic between its rails and the curb and will continue to do so as long as every street

corner becomes a station for the arrival and departure of passengers.

To lay the rails at the side of the street close to the curb would greatly lessen the congestion of moving traffic, but is impractical because no motor cars could be parked at the curb. The elimination of the rails by the substitution of rubber-tired trolley buses with flexible connections with the overhead power wires has been tried successfully. But, in many instances, these rails must be used for long distance and suburban traffic, and at any rate, the tracks, conduits and third rails represent an investment which many trolley companies will not willingly throw away. Therefore, inasmuch as it is the frequent stops of the trolley which add so greatly to traffic congestion, let us reduce the number of these stops as much as possible.

Effect of Trolley on Other Traffic

Trolley transportation should prove a supplement to, rather than a detriment of, street traffic. Why could not existing trolley companies use their rail equipment for long distance hauling with no intermediate stops to take on or discharge passengers? The short haul traffic could be handled by means of supplementary motor buses owned by the trolley company and operated either by gasoline engines, storage batteries or flexible connections with the overhead trolley wires. Such buses could stop at the street corners as easily as a private automobile and could carry all of the local traffic with arrangements for transfers at points one or two miles apart at which the rail-bound trolley cars could stop. The rail-bound trolley, with its infrequent stops, could then travel as fast as its own line of traffic would permit. Under this arrangement passengers could be carried more quickly either by the short haul bus or the express trolley, than is possible under present conditions of traffic. It may be argued that the increased number of buses would so add to highway congestion as to neutralize their benefit, but they could replace almost an equal number of trolley cars now used for the short haul traffic, and because of their ability to pull directly up to the curb to receive and discharge short haul passengers, and to weave in and out of traffic without restriction to rail, I am very positive that the carrying capacity of our streets could be materially increased.

Stationary Traffic

But traffic cannot keep moving continuously; cars are on the street because they have some definite destination in view and this brings us to the most serious of our municipal problems—stationary traffic. If we adhered to the letter of the non-parking restrictions, the ten-minute parking limit signs and the admonitions of some of our city court justices, we could not even stop our car for lunch.

It is not the province of this discussion to describe the various means employed in many of our cities by which parking space may be secured. Diagonal parking, parking in the center of the street, parking with wheels directly against the curb, and side parking are methods entirely dependent upon local conditions.

Temporary Make-Shifts

Some cities are setting aside public squares and parks for the accommodation of stationary traffic. In other cities, large department stores maintain a free garage for their patrons with a service which includes bringing the car to the door when the customer is again ready for it.

But these attempts to improve conditions can be but temporary make-shifts of a situation which is inherently and basically wrong. Ten years ago we were all talking of the saturation point and of the continued ability of the country to absorb new automobiles, and we little dreamed that the real saturation point was the ability of our streets to accommodate the cars already in use.

I am not a close student of traffic conditions and I have no statistics other than those based on daily observation, but I ask you if it will not be absolutely impossible to accommodate on two dimension roadways, occupants of cities who are continually living in three dimensions, for our cities are no longer planes, they are cubes; the third dimension is used by every architect, building contractor and real estate man who wants to add to the value of his property through its ability to accommodate more human beings.

Effect of High Buildings

Just think what it means, for example, when a 20-story office building or apartment house is erected on a certain site. Such a building may well occupy an entire block and may easily replace 30 or 40 houses, each of which accommodates one or two families. If each family owned a car and if each entertained a guest simultaneously who also came in a car, there would still be room at the curb for

the maximum number of 75 or 100 cars involved. Now when these houses are demolished and we add the third dimension to this block in the form of the 20-story apartment house, we may find 200 or 300 families occupying the same ground space which formerly accommodated 30 or 40 families, but under modern conditions of construction and planning, the car parking space has not been increased and there is still no more room at the curb for the cars of tenants and friends than was the case when three-story single dwellings occupied this block.

What is one of the first items that the architect considers when designing his building? He calculates the total area of floor space, estimates the number of persons who will be accommodated on each floor and then allots space for an adequate number of elevator shafts to take care of the vertical traffic. No well-designed and well-managed building will permit of undue elevator congestion even during rush hours, and in consequence far better provisions are made for this third dimension traffic than are available for the tenant of that building whenever he desires to travel in a horizontal direction. Such a tenant, after having been whisked rapidly down to the ground floor, may find that his wife, his chauffeur, or whoever else may be driving his car down for him, have been unable to find any parking space near the building and has been forced to drive around the block continuously. This "merry-go-round" parking is becoming the only solution of the problem in certain sections of our cities.

Here again, we are confronted with the absolute necessity of adding the third dimension to our parking spaces as well as to our highways. We have added the third dimension to our rail-controlled city traffic in the form of elevated structures and subways, but we have as yet found no satisfactory solution other than vague plans, to the problem of securing the third dimension for motor driven traffic, and this traffic relief is vitally needed and must therefore be susceptible of immediate application to existing conditions. It is all very well to plan for the ideal city of 100 years from now, but the problem is not one for our children or future generations to solve, it is one for us here and now.

Problem of the Stationary Car

I firmly believe that the problem of the stationary car is far more serious than that of the moving vehicle. The seriousness of the situation lies not so much in present conditions as in the fact that we are doing nothing to prevent a very serious aggravation of these conditions within the next two or three years. Possibly a remedy must be brought about by legislation. It is true that there are already too many laws, but legislation which will insure adequate parking space for the cars of the future is far better than legislation which will prevent the efficient and effective use of the cars already in operation. The automobile is too effective a tool to have its efficiency curtailed in the slightest by half-baked ideas such as have already been proposed, and which have as their object a reduction in the number of cars which shall use the streets and a restriction of the areas in which they may be kept. You cannot legislate crowds and lawful pedestrians off the sidewalks and it would be equally ludicrous or impossible to prevent highway congestion by saying that cars or trucks belonging to certain individuals shall not be used except, possibly, under given conditions, such as certain hours of the day or certain days of the week.

We must get at the fundamentals and so arrange and design our cities that, as the city grows in population, its ability to accommodate stationary and moving traffic will grow in the necessary proportion. Therefore, the blame for traffic congestion in reality lies with those who are responsible for population congestion and to them we should look for the remedy.

Examine the surrounding street of any large apartment house or office building. We find that such a building, while of course not gasping for air, is literally gasping for parking space. It has reached out its tentacles in all directions and has pounced on every street radiating from it as a center in order to furnish parking space for the cars of its tenants and customers. Nearby private houses which may boast of but one automobile, have their entrances blocked by the cars of those doing business in that building. A nearby public garage is hardly the answer to the problem, for this in itself would occupy valuable ground area and would not be used by those who came to work early enough to find sufficient parking space near the entrance to their building.

Providing Parking Space in Large Buildings

My proposal is merely that, as every modern building is required to devote a

certain proportion of its area to elevator and fire escape requirements, so in the large buildings of the future we should require that they furnish adequate parking space within themselves. This will employ the third dimension—which is the cause of traffic congestion—as a means of relieving that very congestion. This is not so difficult as it might sound, for one sub-cellar or lower floor of the building which may be connected with the street by ramps, could be made to furnish automobile storage space equal to at least 5 per cent of the available rental area of a 20-story building. This would, of course, reduce the rental return of the building by 5 per cent, but if department stores have found it advantageous to rent or construct free garages for the benefit of their patrons, the owner of an office building or apartment house would find it equally "good business."

But we are not considering good business from the aspect of the real estate man. Zoning laws of our cities which have regulated the height of our buildings in order to preserve the architectural beauty and give adequate light to the streets below, have also served to reduce the total gross receipts which may be obtained from a building occupying a certain plot of ground. On the other hand, the benefit to the tenants of the entire neighborhood has been such that net revenues have not been decreased and landlord and tenant alike have been benefited.

Third Dimension Parking

We carry out the same principal of third dimension parking in our suburban homes where many garages are built of fireproof construction directly in the house, as a part of the cellar. Apply this same idea to an office building, making the storage space thus formed available upon payment of a small fee to every tenant who has occasion to leave his car in this vicinity for more than, say, 30 minutes, and you will find an automatic solution of the parking congestion problem which *will keep pace with the growth of the city.* The curb space will then be left free for the cars of clients, customers and others having occasion to leave their vehicles for only a short time.

The foregoing is from a recent address by Mr. Slauson at the convention of the Motor and Accessory Manufacturers' Association at Boston on Sept. 21, 1923.

PROGRESS IN SOLVING THE SEWAGE SLUDGE PROBLEM

(Editor's Note: The full text of the report of the Committee on Sludge, of the American Public Health Association, as presented at Boston, Mass., on Oct. 10, 1923, is here given. Members of the committee are: Langdon Pearse, chairman; T. Chalkley Hatton, C. H. Hurd, Earle B. Phelps and W. L. Stevenson. As the work divides particularly by the organizations handling the investigations, the report is so outlined.)

Milwaukee Sewerage Commission

Mr. T. Chalkley Hatton gives the following notes on the Milwaukee work:

The Milwaukee Sewerage Commission appointed a Fellow to the Agricultural College of the University of Wisconsin who has devoted his entire time to the use of sludge in agriculture. Intensive studies have been made of the values of activated sludge in comparison with commercial fertilizers of different mixtures. Plantings were made of corn, soy beans, Sudan grass, tobacco and other crops at the experimental farms of the University of Wisconsin, at Marshfield, Hancock, Codington, Madison and Wauwatosa. To determine the value for grass in golf greens, tests are being made at the Blue Mound, Ozaukee, Lynx and Tripoli Golf Clubs, and the Milwaukee Country Club and the Pine Bluff Country Club. A large number of pot cultures have also been made at the greenhouses of the University of Wisconsin.

The National Fertilizer Association has also been advised of the possible value of activated sludge. Samples have been sent various fertilizer distributors for investigation. The co-operation of the Executive Committee of the Association has been assured in handling and marketing the prepared sludge should it prove as satisfactory as appearances indicate.

Sanitary District of Chicago

The Sanitary District of Chicago has interested a number of agricultural experiment stations in growing tests. Work is under way on cotton in Mississippi, and on garden plants at the University of Illinois. In the Chicago territory sludge has been distributed to peony and rose growers, truck farmers, cabbage growers and to various individuals. The Lincoln Park, West Side and South Park organizations are trying sludge on lawns and grass plots.

The district has operated a test plot

during the growing season, planting corn, beets and beans, with various combinations of fertilizer. Some 45 plots, each 1,100 sq. ft. in area were planted. The land, while formerly used for truck gardening had lain idle for over four years. The results in general have been encouraging. A record of weights is being kept, as the vegetables are picked, which will furnish a criterion of the real relative production.

In addition, the district has used sludge in seeding grass, in comparison with sheep manure.

The best price obtained during the year on the sale of carload lots was $9 per ton f. o. b. cars for sludge, dried and bagged.

Baltimore

Mr. Milton J. Ruark, Division Engineer of Sewers, gives the following notes of interest with reference to the sludge handling problem of Baltimore. During the year 1922, the total production of sludge was about 5,400 tons on a dry basis. This is the greatest rate of production in any year since 1918, when the output was somewhat greater. During 1922, about 5,500 tons on a dry basis were handled, a portion of this being heat dried sludge from the drying plant and the remainder air dried sludge taken by local farmers. For more than a year no charge has been made for air dried sludge. This season farmers have taken the sludge as often as it is produced by the sand beds, so that the drying plant has not been operated for several months.

At the present time, no income is being realized from the sale of sludge. The city has provided means to load the farmers' trucks from a trestle by dump cars direct from the sand beds, or by a derrick from the storage pile. As a rule the farmer arranges to handle sludge only when the city is operating one of the loading devices. Occasionally a farmer loads his own truck. The sludge is all used within a radius of about 4 miles, whenever possible, the farmers hauling it directly to the field, where it is spread and plowed under. Sometimes it is placed in piles or composted with manure for spreading on the fields at a later date. The farming community served is almost entirely composed of truck farmers. The sludge is therefore used to a large extent for such plants as cabbage, spinach, potatoes, string beans and tomatoes. It is used to some extent on corn, and to a very limited extent on grass. The amount of horse and cow manure available has decreased markedly in the last few years with the result that its cost has reached a point where farmers are seeking other materials for fertilizer. While it is evident that the farmers in the vicinity of the Baltimore plant believe the sludge is worth the handling, the city officials have desired to satisfy themselves of the real value of the sludge in agriculture. In co-operation with the Agriculture Experiment Station of Baltimore, a series of experiments have been outlined to extend over some 4 or 5 years. Nine acres have been laid out in 6 sections of 1½ acres each, each section being divided into 6 plots of ¼ acre each. The whole of each section has been treated with one of the following fertilizers: Liquid digested sludge, air dried sand bed sludge, commercial fertilizer, commercial fertilizer and dry sludge and manure. As a control, one plot has been given no treatment. One-half of each section then was treated with lime in a manner to cover half of each plot. In one plot of each section will then be planted some crop, and likewise with each of the other plots, so that in any year some crop will be growing on ground treated with all of the six fertilizers, both with and without lime. Rotation of crops will probably be introduced, but the ground will receive the same fertilizer year after year. A special experiment with alum treated sludge will also be started on other ground.

At the date of September 15, the farm was already growing late potatoes, beans and fall cabbage. It is proposed to plant spinach and grass seed in the fall and next spring to add another crop, probably tomatoes, making a total of six different crops.

The preparation of air dried sludge for the year 1922 cost $.666 per ton.

Rochester

Mr. John F. Skinner reports that at the Irondequoit plant of the city of Rochester, N. Y., about 10,600 cu. yds. were prepared for market in 1922 by air drying. This sludge was sold at an average price of $0.75 per load of 2 cu. yds. to farmers, delivery being made by a tipple to the teams and auto trucks. When shoveled from storage only $0.50 was received by the city. The sludge is largely used in the top dressings of the orchards for a distance of 7 miles around the plant.

Houston

From Houston, Mr. J. C. McVea reports that during the calendar year 1922, 4 cars

of sludge were sold. The buyers preferred sludge which had not been pulverized. Five tons were delivered to local truck growers and others for use near Houston. The results obtained by various gardeners and by the Houston City Park Superintendent on the municipal golf course and in the parks have been very gratifying. Growing experiments were made on a small scale with turnips, tomatoes, lettuce and radishes, in which the value of the sludge as a fertilizer was demonstrated. In particular, the turnips were vastly improved, the ones fertilized with sludge being the only ones edible, being sound and sweet, the others being dry and fibrous. The results on the turnips are given by the following table:

PERCENTAGE INCREASE OVER UNFERTILIZED TURNIPS

No.	Wt. Tl.	Ozs. Rts.	Tps.	% Increase Tl.	Rts.	Tps.	How Fertilized
1	11	3	8	0	0	0	Not Fertilized
2	18	7	11	64	133	38	Blood
3	41	14	27	273	367	237	Nitrate Soda
4	63	28	35	473	832	338	Activated Sludge
5	59	31	28	436	932	250	Activated Sludge and Phosphoric Acid

Preparation of Sludge

In the preparation of the sludge, development of methods and apparatus is still progressing with very encouraging results.

At Milwaukee, the tests have been concluded on sludge handling, with the conclusion that provision should be made for the use of acid and heat with the Oliver filter.

At the Des Plaines River Sewage Treatment Plant of the Sanitary District of Chicago dewatering has proceeded using alum or acid, with and without heat. At first only a Worthington bag platen press and a Simplex plate press were available. In August tests were begun on a novel hydraulically operated bag press, designed by Berrigan, with direct squeeze, which has the advantage of taking care of any desired thickness from ¼ in. upwards. The press cake (in moisture content from 73 to 83 per cent moisture) is dried in a rotary direct-indirect dryer. A pulverizer is required to crush the balls which occur, though not in large numbers.

At the Calumet Sewage Treatment Works of the Sanitary District of Chicago, dewatering has proceeded using alum or acid on the Oliver filter installed. This filter is the largest size built, the drum being 11 ft. 6 ins. diameter with a face 14 ft. wide. Space has been left in the house for a Basco-ter-Meer centrifugal. A dryer similar to the one at the Des Plaines River Sewage Treatment Works operates on the sludge cake intermittently.

At the testing station, operated jointly by the Sanitary District and the Corn Products Refining Company at Argo, tests have been run on plate filters and a single wheel American rotary filter. Alum has proved more successful as a coagulant than acid.

At Houston, the cost of preparing the sludge has not yet developed to a point where definite costs can be given. Several methods have been tried. At present the use of sulphur dioxide gas is being tried to prepare the sludge for pressing. There has been no complaint of odor from sludge handling or the preparation of the sludge.

The nitrogen recovery in activated sludge at the various points of operation is as follows:

ACTIVATED SLUDGE

Recovery of Nitrogen and Phosphoric Acid
Nitrogen as N; Phosphoric Acid as P_2O_5
Per cent dry basis.

Location	N	P_2O_5
Sanitary District of Chicago—		
Argo	7 to 8	6 to 7
Tannery	3.0	
Packingtown	4.2	2.7
Des Plaines R.S.T.W.	4.5 to 5.5	2 to 4
Calumet S.T.W.	4.2 to 4.4	
Houston	4.6	1.9
Milwaukee	6.0	2.3

By the alkaline permanganate method the total available ammonia in the Milwaukee sludge is 4.61 per cent, 63 per cent of the total ammonia.

TABLE 1—PRODUCTION DATA AND ANALYSIS OF SLUDGE REPORTED FOR 1922

City and Plant	Baltimore—Hydrolytic	Rochester—Imhoff	Chicago—Activated	Houston—Activated
Production in 1922, net tons dry weight	5,421	6,440	400*	70†
Air dried—cu. yd.		10,600		
Analysis on dry basis		Per cent		
Nitrogen				
Average	2.45	2.00	5.0	4.6
Maximum		2.17	5.6	
Minimum		1.95	4.3	
Phosphoric Acid	0.52	0.8	2 to 4	1.9

* Approximate amount on 12 months 1922-23.
† Produced for experimental use and sold as fertilizer, estimated production would be 1,720 tons, if prepared.

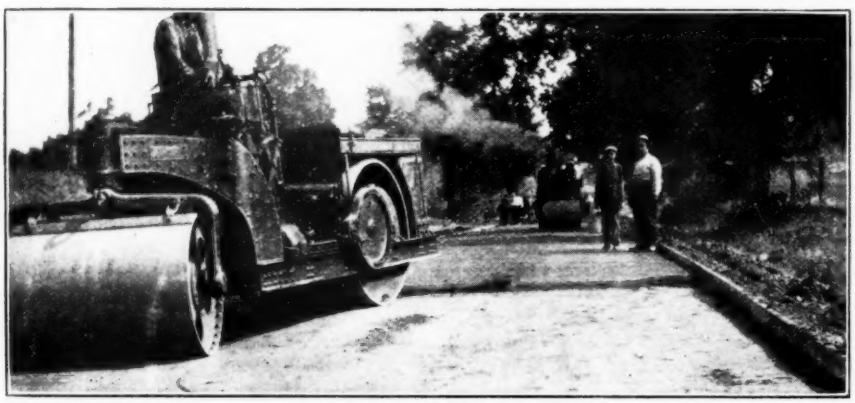
ILLINOIS' FIRST BLACK BASE HIGHWAY

By Gene Abson, Chicago Paving Laboratory, Inc., Consulting Engineers, 160 N. Wells St., Chicago, Ill.

Increasing demand for better pavements on our heavily traveled highways, which will successfully withstand the effects of traffic, has led engineers to seek alternate types of construction for Portland cement concrete, or concrete bases with different wearing surfaces. Naturally they have turned toward the Pacific states and the Eastern section of the United States where black base pavements have been successfully constructed for many years with comparatively low initial cost and almost negligible maintenance expense. That this type of pavement has withstood the forces of destruction occasioned by extremely heavy traffic, has been known for years by advocates of flexible pavement design, but until this summer no real black base highway pavements had ever been built in Illinois or adjacent territory. Engineers who have confined themselves to rigid types have constantly maintained that black base could not be used in Illinois because of the soil conditions.

By "real black base" is meant the laying of the bituminous concrete foundation directly upon the excavated and rolled native subgrade, omitting any subfoundation such as old gravel or macadam, or newly laid rolled stone. Now that the "ice has been broken," so to speak, by the construction of the Brush College Road in Decatur Township, Illinois, a well-traveled connecting link, one mile in length, it is anticipated that the future will mark much wider use of flexible pavement design in Illinois and the neighboring states as a standard form of construction. It is the intent of this article to point out some of the important features attendant upon laying this type of pavement on typical Illinois silt-loam subgrade. This road is located in Macon County, adjacent to the city of Decatur.

The Brush College Road, previous to this improvement, was a narrow, worn-out gravel roadway. In reconstructing, the grade and alignment were changed throughout its length so that none of the old roadbed could be utilized in an undisturbed condition; it possessed no value whatsoever as an artificial subgrade. The subgrade, except for a short stretch of clay, is of the same character as that underlying the Bates Experimental Road and of poor load-supporting power and which necessitated somewhat greater thickness of foundation than is the practice on the West coast. Instead of the usual 3 ins. of black base with 1½ in. sheet asphalt wearing surface, it was decided to make the foundation 5½ ins. in depth with a 1½-in. top, giving a total thickness of 7 ins., which is considered superior to the standard Portland cement concrete design, or the 6-in. Portland cement concrete base with 1½-in. binder and 1½-in. sheet asphalt surface. It was not, of course, necessary to use a binder course, as the black base, composed of dense asphaltic concrete, in addition to acting as a foundation, functions also as a binder course by offering a positive means of adherence for the sheet asphalt top. On subgrades composed of gravel or old macadam, thor-



BLACK BASE HIGHWAY CONSTRUCTION ON BRUSH COLLEGE ROAD, DECATUR TOWNSHIP, ILL.

Rolling Subgrade in Foreground; First Course of Black Base in Place. In Extreme Rear, Laying Second Course.

oughly compacted by traffic, it is believed that 3 to 4 ins. of black base with 1½-in. asphalt wearing surface is equivalent in all respects to the standard Portland cement concrete pavement of 6 or 7-in. depth by virtue of its flexibility and shock-absorbing ability; while in many ways it is very much superior since it is free from the common evils due to thermal expansion and contraction, and is moisture proof.

The contractor's organization had never laid black base before, nor had the local engineers in charge of design had any experience with this type. It was only natural, then, that some features should be encountered during construction that might have been avoided through previous experience. One difficulty which was encountered was the weakness of the side forms which did not provide sufficient lateral support for this type of construction. During the construction of the base, considerable lateral pressure is exerted by the heavy rollers in compacting the hot mixture. Three methods were suggested originally, as follows, in the order of their merit:

(1) A reinforced Portland cement concrete retaining curb, flush with the pavement, about 12 ins. deep and 12 ins. wide.

(2) A header, or heel, of asphaltic concrete, tamped in place about 6 ins. below the base of the foundation, and 8 ins. wide.

(3) Three-inch wooden plank header supports, held in place with stakes, and which were to be left in place.

For the sake of economy, as the funds were limited for this work, the latter was selected, but 2-in. lumber was used and the stakes were not set close enough together to provide uniform support. Heavy oak planks would have minimized this feature but the difference in cost between this and the curb would place the curb as first choice.

If it had been possible to prophesy that an unusual heavy rainy season would occur, the work could have been started on the opposite end from where construction began. This would have found the south end, which was all of the black loam character, completed before the rain set in and would have placed the construction of the north end in the rainy season. This north end subgrade was composed of a portion of clay and gravel which drained more readily and did not lose its supporting power when wet, as did this black dirt. Then, too, the drainage ditches over the entire road had not been entirely completed, nor cleaned, nor had the shoulders been placed and trimmed to allow normal drainage. All these factors were, of course, disadvantageous, both from the standpoint of construction and delays to the contractor. Future work of this type will doubtless find contractors paying more attention to these details, which are extremely important.

The black base itself, as was anticipated, proves to be extremely easy of construction and manipulation. All of the methods of procedure common to the usual asphalt pavement construction

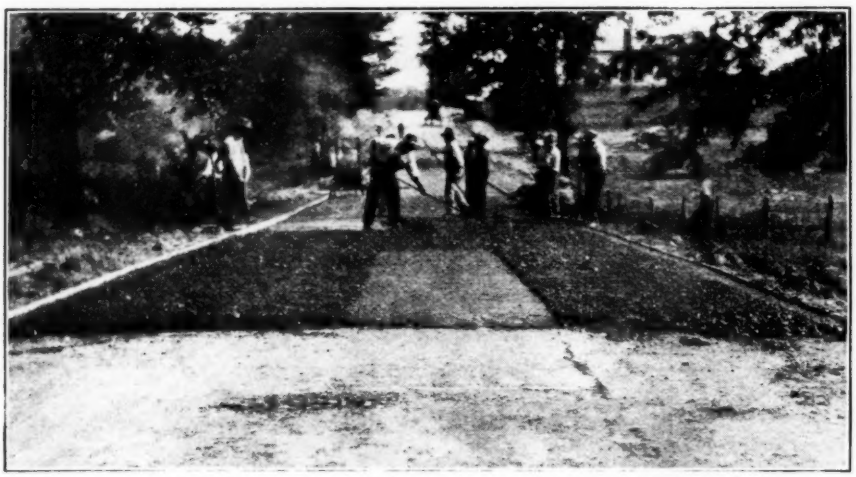
BLACK BASE HIGHWAY CONSTRUCTION ON BRUSH COLLEGE ROAD, DECATUR TOWNSHIP, ILL.
Rolled First Course and Finished Subgrade Shown in Foreground. Laying Second Base Course in Background.

were followed. The same materials were used with the exception that the construction of the base in two courses permitted the use of aggregates up to 2½ ins. in size. The same plant and mixer were used to prepare the base as would be used for any asphalt paving work, and absolutely no difficulty was experienced in handling stone larger than is customary with wearing surface mixtures.

The black base mixture averaged about 4.5 per cent bitumen, 35 per cent sand and 60 per cent crushed limestone. This is somewhat less bitumen than the average asphaltic concrete binder contains, but was ample for the grading of this aggregate which, on account of its larger maximum size, offered less surface area per unit volume. An extremely dense mixture was secured by reason of the exceptionally well graded stone which compacted readily under the rollers. As mentioned previously, the base was laid in two courses, the first 3 ins. in depth and the second 2½ ins. thick. This is probably not quite as satisfactory as laying all in one course and rolling with heavy three-wheeled rollers, but which was not possible on this road as the wooden headers could not sustain the pressure. One important feature was noted here, namely, that the second course of base, in order to secure proper adhesion, had to be laid before the first course had entirely chilled. When this was not done, the second course did not always form a perfect bond with the first course, due to the fact that the large stone mixture was not capable of being forced into the surface voids and interstices of the extremely dense bottom layer. This, however, was not true of the sheet asphalt top as it adhered tenaciously to the black base. The sheet asphalt wearing surface was designed as a moderately heavy traffic mixture, and showed an average analysis as follows:

Bitumen	10.8%
Passing 200-mesh	16.2%
Passing 80-mesh	30.0%
Passing 40-mesh	32.0%
Passing 10-mesh	11.0%

On grades the filler was increased to about 22 per cent; the asphalt cement used for the black base and sheet top was identical, of 40-45 penetration.



BLACK BASE HIGHWAY CONSTRUCTION ON BRUSH COLLEGE ROAD, DECATUR TOWNSHIP, ILL.

Spreading Second Layer of Black Base. First Layer Shown in Foreground. Wagon Shown on Completed Pavement in Rear, Clearly Demonstrating the Immediate Availability of this Type of Pavement for Traffic.

It may be true that some portions may settle in time, especially over weak portions of the black dirt subgrade or new fills, but this will cause no disastrous results. Such areas as do settle can be easily and effectively patched, the patch becoming an integral part of the pavement, and if carefully done will not be discernible. This feature of flexible pavement design; that is, its tendency to seek uniform contact with the subgrade, is one of its principal assets. It appears that a logical method of road construction is to seek this end rather than at-

tempt to design a slab or beam which will indefinitely bridge over unfilled areas created by settlement of the subgrade; the latter procedure necessitates increasing the thickness of the slab with increases in traffic and decreases in load support afforded by subgrade; increasing the strength of the concrete itself has already progressed to a maximum.

In addition to possessing the quality of flexibility, black base pavements distribute and absorb the impact of traffic by reason of resiliency, thereby decreasing the possibility of subgrade failures. Black base being absolutely impervious to water, eliminates the effect of that which has been termed "moisture expansion," which though not a rapid force of destruction, may, nevertheless, be serious. The effects of frost action within the structure are also eliminated by this moisture-proof quality. One serious defect in Portland cement concrete which can not be eliminated is the result brought about by temperature changes in the expansion and contraction of the slab. The effects of thermal expansion may be evidenced by explosions, heaves or profuse cracking, and the use of bituminous expansion joints has not entirely cured these disturbances. With black base pavements, the danger from this source is eliminated.

It will be interesting to observe the measure of service given by this mile of 7-in. solid asphalt pavement as compared with that afforded by the latest design of Portland cement concrete in the road with which it connects. If an asphalt base job was ever laid under adverse conditions upon a subgrade of questionable value, surely this is the one. Advocates of rigid types have frequently made the statement that black base could not be built under Illinois soil conditions and even if this were actually done, it would not begin to approach Portland cement concrete as a serviceable highway pavement. But the construction has been accomplished under the worst conditions that could exist in Illinois or elsewhere.

A considerable portion of the credit for this project is due to the Highway Commissioner of Decatur Township, who has had implicit confidence in the virtue of black base and stood almost alone at times in the determination to see it done despite much adverse criticism.

RELATION OF CHAMBERS OF COMMERCE TO CITY ADMINISTRATIONS

By Felix M. McWhirter, President, Indianapolis Chamber of Commerce, Indianapolis, Ind.

Let me direct your attention for a little while to the contrasts of living today as against the life of only two decades ago. Twenty years ago we did not have in general daily use the automobile, the truck or the tractor, the movie, the telephone and telegraph, electricity for power (and very little used for illumination), the phonograph, and sanitation as we now know it. We have now, resulting from these discoveries and inventions—good roads, means of more quickly transmitting information, a larger potential individual earning capacity, and an easier means of living in comfort and pleasure with our families.

Yet, we have demanded more and more of government.

In the country our children must now be hauled to a most modern type of school building thoroughly equipped, over excellent roads—many of them hard surfaced—in a motor vehicle designed for the purpose—equipped so that the temperature and humidity may be just right. Last year we paid in Indiana two million dollars for such service.

In the towns we must have our streets, and even roads, lighted. They must be policed. Our ashes and garbage must be cared for. Our city streets must be paved, sprinkled and kept clean. We want parks and public grounds. We, in towns and cities, must have adequate and modern means of fire protection. All these cost money—cash money, not credit.

We have been a pretty busy people looking after our own business and well-being all the while. Most of us have produced more than we have consumed. Many have laid by either for the education of our children or for endowing our old age, or both. Most of those who have not saved, have subscribed for insurance in some form at least.

Increasing Cost of Government

Now, what has been happening all the while? Costs of government have been ever increasing, partially because of the public demand for increased service in the various manners before mentioned, and partially because of the incompetence of those charged with the responsibility of spending the taxpayers' money.

Mr. Albert J. Beveridge is quoted as

having recently pointed out that prior to the Civil War we had on the taxpayers' pay roll, Federal, State, County and Local, one employe for every 1,000 of our population, whereas during the Cleveland administration 1 was supported for every 500 as contrasted with today, with 1 for every 19 of the whole of our population. One for every five families on the average!

Taxpayers Getting Interested

If it were not on the average—if every five families supported or paid for the efforts of a single public servant in whatever capacity—do you think the five heads of households would want to know what their pay roll went for?—whether or not their employe was capable of expending vast sums of money economically and wisely? Surely they would! But too many have not realized yet, that they are paying the fiddler. But business is realizing it, the grocer, the hardware merchant of your town realizes it—the real estate owner is now realizing that he pays heavily whether he owns town property or farm lands. They are all getting inquisitive.

A Story Worth Telling

The average man used to be too much like the darky in one of Bill Herschell's stories. Bill tells of an old timer, an innkeeper, down in the hills of Kentucky, who had been elected Justice of the Peace in that little hill billy community of some nine or ten hundred souls. After some two or three weeks without a case, he one day called in the constable and looking over his specks said, "How comes no cases for this here court?" The constable replied, "There just ain't been any, that's all." The Justice of the Peace then said, "Well, I just guess that we're all going to have some court here. Get out and bring in some niggers." The constable went forth reluctantly and wound his way up to the alley end of the livery stable, climbed carefully up to the loft and eased in on a live, black crap game just as Rastus, with eyes gleaming at the two-bit piece on the floor in the center of the circle, was warming the bones and pleading daringly, "Fade dat; all or any part." There were six darkies there until the constable set his foot over the top step of the ladder, then there was one. He stopped warming the bones, his hand in mid air, as he looked up in the face of the constable, saying, "Yessir, yessir." The constable walked him into the little old hotel where sat the J. P. at court behind the single lobby table. "What's he charged with, shooting dice?'

"Yes, sir."

"Guilty or not guilty?"

"No, sir, boss, I ain' guilty. I jest couldn't be guilty. Why, I wuz just warming up the bones. I wuzn't even faded."

The J. P. leaned over, wet his fingers, turned several pages of a book, and pronounced, "I find you guilty, $22.82." Rastus saying, "Yassir, yassir," as he looked at the book, reached down and paid without a whimper.

He was released and upon joining his buddies around the corner, told them his story in answer to their anxious questioning. They guyed him and upbraided him for paying so easily. He answered with, "Who's been arrested, me or you? Who paid out $22.82? I did. And didn't I see that old Justice of Peace turning pages of dat book, and I seen what dat book was. It ain't no law book. It wuz a Sears-Roebuck catalogue, dat's what it wuz! And he wuz in the baby-carriage part. Who'd help me if he eber turned on over into the automobile section?"

Looking Ahead in Public Financing

Has it occurred to you that no bonded indebtedness should be created, even though the legal bonding limit of your community has not been reached, until after due consideration has been given to its amortization and the effect on the tax rate, present and future? No community or government obligation should be put out that does not oblige a definite fixed rate of retirement and such rate of payment should be governed by the use to which the money is put and the certain length of useful life of the improvement.

"Tax Exempt"

If a citizen of your town wishes to erect a building for commercial or apartment use, and needs financial assistance, what does he do? Can he get the use of his bank's money—can he borrow from the government? No! But he can incorporate and sell preferred stock called "tax exempt." Well it is tax exempt to the purchaser because the borrower must pay the taxes. To pay 6 per cent tax exempt, the borrower must earn 10 per cent at least on his realty, and net of all expenses—so, we find high rents. Then we have the state, the county, and the city in competition for money, men and materials,offering 4, 5 and even 6 per cent for money and tax exempt, too, both to the loaner and the borrower.

If all of you would enter into a municipal program of improvement at the same time, and that program for completion in two years, say—what would result? You would grind out more tax exempt securities in competition with business, yes—but unfairly, too—for you would employ workmen needed in productive work, pay interest on the money so expended for the balance of their days. In 1882 Marion County, Indiana, built a court house and to this day $400,000 of its cost is still unpaid—just interest, interest, interest.

How the Chamber of Commerce Can Help

But why a Chamber of Commerce, and how can it help you in municipal government? If the business men of any community all want the same thing for their city at the same time, they generally get it—but is their goal a proper one, have they studied it from all angles? Too many times some want this or that just while others are sure that the present municipal undertakings are deplorable. A Chamber of Commerce is a voluntary organization, born with one sole underlying purpose—the common good. It is supported by citizens zealous for the community good, all interested in its commercial, industrial and civic development. A Chamber of Commerce supplies a continuity and a persistency of effort. Sustained effort is set in motion only after facts have been obtained and possible methods of procedure canvassed. A thorough study is made by a committee which submits its findings by recommendation to the Board of Directors for approval. If they approve, it then becomes a commitment, the lasting duty of the executive officers and paid staff to persist to the end that there is accomplishment.

Where the Average Citizen Gets Action on His Ideas

In the past, one of the greatest drawbacks to municipal development has been the fact that the average citizen took no interest and very little if any active part in the administrative affairs of his city. The feeling of helplessness on the part of any individual is soon dispelled if it is possible for him to place his suggestions or criticisms before a responsible organization that will carefully analyze and ascertain the facts and merits.

Almost daily, the Indianapolis Chamber of Commerce has occasion to support the efforts of some department of local government. There are times, too, when we believe that we have helped constructively. Rarely is it necessary for us to criticise. Our effort is to work with the administration for the common good.

Helping the Public Official

When a man goes into public office and especially where the affairs of a city are left to him, we presuppose that he is a man of affairs, intelligence and with sane ideals. Is that man to go ahead with a program which would be within his own power, and assisted only by his co-workers in the carrying out of that program? Or is he going to ask his assistants, through the particular departments concerned, to take up the proposed plan with the Chamber of Commerce, get the opinions of experts, have them place the plan before their working committees, or get them to appoint a special committee, and more than that to let the public generally learn by public expression from the Board of Directors of the Chamber of Commerce that the program is a proper one and to be supported?

Co-operation With Chamber of Commerce

Why does he wish co-operation from his Chamber of Commerce? Because of his faith in the town in which he lives, because of faith and confidence in his civic organization. He knows that the Chamber of Commerce is ever on the alert to lead or to assist in anything for the good of the city and the people in it. Civic activities are those which promote public welfare and benefit the community. The apathy of previous years has given way to interest, and among the more progressive, to a very active interest in studying and molding city conditions. A thriving, steadily growing town, village, or city is a better place to live in and to work in than one just keeping up or lagging behind.

Business Men Can If They Will

A mayor of an eastern city once said that there is no body of men in any community that can exert a greater and bette influence for the public good than the business men, if they will. They have proved it on many occasions and they can and will again show their power for good whenever the occasion arises. If a Chamber of Commerce is going to work with the city administration and bring the best out of the men in the city's service, the people of the city must evidence their appreciation of the faithful work of the men of the city administration.

Even a child can be "more than a voter" to an extent too little appreciated by most of us. But look at the splendid

attitude of our present city administration in Indianapolis and what they are doing with and for our children! The organization of traffic squads throughout the various schools in Indianapolis is just another step forward. They are being organized along the same lines as our Traffic Department itself—it is an education to the children in the government of their City and it is an excellent illustration of "Safety First" in addition to imbuing them with a feeling of responsibility for their neighbors.

The modern Chamber of Commerce parallels the municipal and county governments—not for purposes of criticising—no—but to lend that experience of fact which has operated successfully in local community affairs, or in affairs of other localities.

The foregoing is from an address by Mr. McWhirter before the 1923 Convention of the Municipal League of Indiana.

THE TEST HIGHWAY AT PITTSBURG, CALIFORNIA

By Lloyd Aldrich, Mem. Am. Soc. C. E., Consulting Highway Engineer, Merchants National Bank Bldg., Los Angeles, Calif.

The need of additional technical information for solving many problems involved in the building of durable highways is keenly felt by engineers, and the interest of the public who furnish the funds for improvements is scarcely less keen. Appreciating this situation, and also believing that a grade of steel that it could manufacture would aid in improving results under difficult construction conditions, the Columbia Steel Co. was prompted in February, 1921, to undertake a highway research at Pittsburg, California.

While this type of investigation was new to this Company, like other corporations they were accustomed to undertake research. The Company placed this work in charge of the writer with John B. Leonard, structural engineer, as associate, with instructions to make it thorough and to collect all data practicable that would add to or confirm present information, and to invite cooperation from all who would take an interest in such an engineering study. These were the only instructions the Columbia Steel Co. ever gave but their co-operation was always in evidence and they consistently paid the bills. As the material in which the Columbia Steel Co. was interested was a special bond, high elastic limit open hearth reinforcing steel (not patented), the test naturally became one of Portland cement concrete pavements.

Outline and Object of Tests

The intention was to secure information on the relative merits of enough different types of pavement, including types embodying the ideas of the Columbia Steel Co., to enable engineers to design highways with greater certainty of results. To insure construction methods that would parallel those used on actual highways, only those already found practicable in the field were adopted. It was one objective that this test would represent to the fullest extent the ideas of engineers and officials actually engaged in highway construction.

The plan was for a track of two tangents, joined with semicircles and wide enough to permit two lines of travel. The foundation for the pavement was on adobe fill, since such soil, which is found in certain locations in the western and southern states presents, particularly under fill conditions, one of the most difficult construction problems. The complex action of adobe, particularly under variable moisture conditions, is a source of trouble and failure. It was intended to investigate the efficiency of both plain and reinforced concrete pavements of variable thickness and design on such subgrade. The effect of the expansion and shrinkage actions of adobe subgrades due to variable moisture content, on pavements was to be given special attention.

Professional Assistance

The selection of designs to be used became an important question. It was considered vital that the designs should represent the ideas, as far as possible, of the engineers engaged in highway construction. Accordingly a questionnaire was sent to all California engineers who were understood to be interested in this class of work. Many designs were received, frequently with supporting arguments more complete than could be conveyed by merely answering the questions. The sentiment was unanimous that the test should be conducted on adobe soil.

As a result the program adopted included 13 types of concrete pavements. Of these, three, Sections C, D and L, were designed by the Columbia Steel Co. All of the other types are the result of the questionnaires and designs of various engineers.

Commercial Assistance

Upon their own responsibility the engineers in charge submitted an outline covering the various features of the undertaking to several commercial firms interested in road building and asked for their assistance. Encouragement and support from these interests followed in an unexpected degree.

Construction

A location fulfilling the desired conditions was secured on the outskirts of the city of Pittsburg, through the kindness of Mr. W. E. Creed, president of the Columbia Steel Co. It had been used only for farming and was at the time seeded to grain.

One of the leading highway contractors of California built the test road, under specifications and engineering supervision, and with a crew and grading equipment that had been engaged on a contract in the interior of the State.

The construction of the tunnels and grading was started May 1, 1921, and completed June 28, 1921.

Concreting commenced June 29, 1921, and was completed July 11, 1921. The plant for the concrete work was loaned by dealers and operated by the contractor. The device for placing the reinforcing steel was designed and furnished by the Columbia Steel Co., and proved to be very satisfactory.

Observation Tunnels

An important feature of the test was to be a study of the stresses to which concrete pavements are subject, especially stresses of flexure. Since the usual strain gauge procedure for measuring stresses on the surface of concrete is largely for static load conditions, which are not completely representative of the action of the highway, it was desirable to supplement this method to include the action under moving and impact loads.

Direct observations of the normal action of pavement under moving loads could only be obtained from the under side of the pavement. Tunnels were accordingly built under Sections B, D, G and I at such depth that there was sufficient earth between the roofs and the bottom of the pavements to insure normal action. The tunnels were as narrow as permissible to permit observations and extended across the entire section of the pavement into the tunnels with the upper ends cast into the concrete. By means of delicate instruments the slightest movements of the rods could be observed and recorded under any loading. Another similar set of rods was installed for studying the action of the subgrade. The upper ends of these rods were fastened to flat plates resting on the subgrade directly under the pavement. The lower ends projected into the tunnel for corresponding observation.

Level Observations

Level observations begun Sept. 28, 1921, were expected to yield information regarding the action of the adobe under variable moisture conditions. A few days showed movements of the pavements that could hardly be accounted for by any reasonable action of the subgrade. It was apparent that a more accurate and intensive study of these motions was essential.

Temperature

Movements of the pavements due to changing temperature were originally expected to be horizontal, so an extensometer with a ratio of about 60,000 to 1 was provided for their measurements. Careful observation soon clearly indicated vertical pavement movements that were continuous and probably the result of variable temperatures. Correlation of the rate of change of temperature of the concrete in the pavement throughout its thickness, with closer observations of the vertical movements showed that these movements were caused by variations of temperature.

Crack Record

The visible effects of traffic on the pavements were noted by crack records, which required the daily plotting of all cracks as they appeared, and also of distintegrated areas, on specially prepared drawings to scale. For this purpose the entire track was painted into 6-ft. co-ordinate squares, so that the location of each crack could be readily plotted. The crack record also shows the dates on which cracks occurred and their extent and so shows very accurately the history of the behavior of these pavements.

Ditches and Moisture

Ditches built on each side of the road could be filled with water from an elevation below the base of the new fill to the elevation of the bottom of the pavement. Thus moisture conditions could be made to correspond to a rainy season or to a condition that too frequently occurs where irrigation exists. Equalizer pipes built in the grade insured the same water elevation on each

side of the road. As it was expected that the investigation would be completed before the California rainy season, water was piped to the test.

On Dec. 21, 1921, the ditches were filled with water to the elevation of the bottom of the pavements. This water level was maintained in the ditches until the traffic was discontinued, Jan. 30, 1922. However, the water was not drained away until the middle of March, 1922. It was anticipated that with the ditches full of water the grade would soon become saturated and the destruction of the pavement accelerated. The rains were also expected to contribute very materially to this result. This opinion seemed to be shared by visiting engineers who had experience with adobe under such conditions. The result did not meet the expectations. Only a very small amount of additional moisture was taken up by the grade. The moisture determinations of the borings indicated that beyond a lateral distance of 2 ft. from the water the absorption was very small. The resistance of the grade to moisture penetration can be attributed to the manner in which it was built.

Tunnel Observations

The first study in the tunnels was of the action of the pavements under truck loadings. A Standard truck equipped with solid rubber tires, loaded with pig iron till gross weight was 7¼ tons, was used throughout the investigation.

Observations were made for static, moving and impact conditions of this truck before regular travel was started, and also one day each week during the entire traffic period.

The deflections* of the pavements under static conditions were determined for three selected positions along the line of travel—one at each side of the track and one on the center, and in a few cases two trucks, both loaded as was the test truck, were used.

The moving truck tests required the truck to travel twelve miles an hour, over the positions of the static tests. It was found that the deflections for this condition were less than those for static loading.

The impact tests were made by passing the truck over a triangular strip of board, causing a vertical drop to the pavement directly over the pavement rods. The speed of the truck in this test was always twelve miles per hour. The position of the impact board was determined by trial so that the point of the initial blow from the rear wheels would be on the line of the tunnel pavement rods. The positions of the impact tests were the same as those for the moving and static observations.

So far as could be determined, there were no cracks in the pavements over the tunnels caused immediately by 236 impacts of the truck in these special impact tests.

Traffic

Traffic was started Nov. 9, 1921, in two lines moving in opposite directions. These two lines were continued until Dec. 24, 1921, when, due to broken conditions of some portions of the track they were changed to a single line. The single line was continued until Jan. 29, 1922, when traffic was suspended until June 1. When the second period of traffic was begun on June 1, 1922, the pavements had been thoroughly repaired and travel was again in two lines, and so maintained for the balance of the test. Traffic was finally discontinued on July 27, 1922, with an intermission between July 1 and 24. For a short time during this second period traffic was also started between 4 and 5 o'clock in the morning, when the edges of the pavement were "curled up." Gross loads were also increased during the test from a uniform load of 7½ tons to loads in some instances as great as 13½ tons.

The U. S. Bureau of Public Roads and the California Highway Commission each supplied 20 trucks, and the California Highway Commission furnished all of the drivers. The daily average of trucks on the track was about 32 as long as the double lines of travel could be maintained. This number of trucks was determined to be the best for passing the largest tonnage over the track each day, as more trucks tended to retard the speed of all, thereby reducing tonnage. When it was found necessary to reduce the travel to a single line, the average was about 19 trucks. A speed of about twelve miles an hour was maintained throughout the tests. It was soon found necessary to give the drivers a 15-minute rest in the middle of the forenoon and afternoon, as four hours of continuous driving of this character was more than could be safely driven. There was thus 7¼ hours of travel each day and this

*Deflections first became manifest when the truck was about 15 ft. from the axis of the tunnels.

schedule was maintained six days of the week. The day that travel was suspended was utilized for making tunnel tests.

Upon the completion of the truck travel test on July 27, many of the sections were still in serviceable condition.

These sections were subsequently subjected to an excessive moving load on a trailer, which could be loaded to 50 tons on a single axle. The tires of each wheel were two 5-in. steel bands. The first load was 15 tons on the axle.

There were a few accidents during the operation of the trucks. Only one, which was serious, but not fatal, occurred during the test and that was to one of the drivers while parking the trucks at the end of the day's run.

The 18-ft. width of roadway was soon found to be as narrow as could be used with the two lines of trucks with complete safety. Even with this width, expert drivers would sometimes run off the tangents as well as the curves.

When the rains started, the adobe sticking to the wheels of a truck that had been off the track soon formed a slippery coating on the pavement that caused much trouble. Under this condition a deep rut was soon formed at the edge of the pavements for a considerable portion of their length. Efforts to keep the track clean were ineffectual, even for a few hours, and the distrust of the drivers increased. This obstacle to traffic was so serious that its correction became imperative. Trenches on both sides of the pavement were made throughout the length of the track and filled with ballast of old furnace brick. These trenches were made by running one of the rear wheels of a truck along the edge of the pavement, which operation made a depression the width of the tire and about 1 ft. deep. All of the drainage of the pavement during the major portion of the winter or rainy season ran to these trenches. A few run-offs to the side ditches were dug, but they were sufficiently frequent to insure only a very moderate drainage.

The ballast was allowed to remain in position during the remainder of the test. It was compacted somewhat by trucks getting off the track but undoubtedly permitted a much freer circulation of air at the edges than would have existed if the trenches had been filled with earth.

Repairs to Highway

No attempt was made to maintain the track during the traffic period, with other than temporary repairs. These were made with the sole object of avoiding the interruption of the travel without affecting the strength of the pavement. During the early part of the traffic a mixture of adobe soil and crushed rock lightly sprinkled with water was used. This method had to be abandoned during the rainy season and a more substantial construction adopted. One such method was to lay two courses of 2-in. plank at right angles to each other and on them a course of building brick. The building brick was then covered with 2 ins. of penetration macadam. Fairly good results were thus obtained but in some cases it was found advisable to use a heavier construction. A layer of 12x12-in. timbers 8 ft. long were accordingly laid normal to the axis of the pavement and on them were laid, transversely and longitudinally, two courses of 3x6-in. timbers. These were covered with a $\frac{5}{8}$-in. steel plate. In a few cases precast slabs were used instead of the timbers. During the June and July traffic of 1922 an oil macadam was used for maintenance purposes. Repairs were promptly made during this period so that the double line of travel was continued without interruption.

Subgrade

The adobe soil at Pittsburg, which was ploughed, scarified, pulverized, sprinkled and rolled in 6-in. layers, as previously described in the construction of the test road, was sufficiently impervious to seeping waters from the flooded ditches to maintain a compact and suitable subgrade. The ditch water standing on each side of the road for about three months did not to any extent penetrate the adobe. Moisture soil samples taken from the shoulders 3 ft. from the edges of the pavement and also from under the pavement showed a very small change in moisture content for this period. The expected characteristic heavy cracking of adobe soil was not as extensive on the shoulders or on any part of the soil that had been prepared and rolled as above indicated. The swelling and shrinking action of adobe, where the soil was not treated at the test highway, is, however, evident, but no evidence of such action was detected in the soil over any of the tunnels. The base line pens in the tunnels did show a slight lowering of the pavement but the rate was approximately constant. No vertical

fluctuations in the pavements due to the slightly varying percentages of moisture could be detected.

This method of preparing the adobe soil for the subgrade involved a relatively small additional expense over present practice and warrants further study of such roadbeds, which occur under actual conditions. It may develop that soils which have heretofore caused so much trouble for highway engineers may thus be made into an excellent subgrade.

Surface Wear

The heavy rubber-tired truck traffic put over the unsurfaced concrete pavements did not cause any surface wear. White lines painted on the pavement in 6-ft. squares so that the cracks could be plotted with facility were never effaced although frequently, during the winter, layers of soil were deposited on the road by trucks that ran off onto the earth shoulders, and these layers were removed by scraping irons and by sweeping. At the end of the January traffic the white lines showed plainly except in a few small areas where the surface had been ground off by the screenings picked up by the rubber tires from adjacent repairs. The lines were, however, dirty from the frequent deposits of soil and it was decided to repaint them for the June travel. Close inspections of numerous portions of the pavement that were on the lines traveled by the truck wheels yielded no evidence of diminution of distinctness of the finishing tool marks as the test progressed.

But a very limited metal-tired travel showed a surface wear that would be destructive. The two-wheel trailer with 10-in. wide steel tires was operated over the road for several circuits with a 15-ton load, and it was clearly apparent that this load on steel tires broke any small irregularities with the first passage of the trailer and with each succeeding passage additional surface destruction followed.

Traffic

It would be desirable to express the 7,362,000 tons of traffic that passed over this test road in terms of years of service of a highway if that were possible. This problem involves assigning limiting values to conditions based on individual judgment and experience. Consequently, results will differ.

The tonnage of the Pittsburgh test was confined exclusively to heavy trucks. The lightest was 7¼ tons and the heaviest 13½ tons.* The application of these loads was very much accelerated as compared with conditions that exist on the public roads; the intense duty of the test road is indicated by the fact that during one day's traffic of 7½ hours, there were practically 5,000 trips on each line of travel, making, when double lines of trucks were operating, a total of 10,000 daily trips. When traffic was confined to a single line on account of broken areas in the pavement, only 3,500 daily trips were made.

Deflections Under Traffic Loads

The excellent condition of the track at the end of the scheduled traffic test made. it desirable to apply an ultimate destructive test and a 50-ton axle load which gave a pressure of 5,000 lbs. per lin. in. width of metal tire was applied and produced structural failures in five of the 13 sections, A, B, H, I and L. The remaining sections showed that they were able to carry this load satisfactorily. The weaknesses of these five sections, however, made it impracticable to continue this test. The deflections of rods No. 9 were noted under a 7¼-ton truck traveling 12 miles per hour with the outer wheels passing over rods No. 9. These rods were practically in the direct line of travel of the outer wheels of the trucks during the period of double-line traffic.

A summation of these deflections is of interest and possibly significant. However, the results are not all strictly comparable because of the difference in temperature at the times the observations were made. If the temperature conditions were assumed constant during a day's run the results would show that rods No. 9, in this period, had a total accumulated downward movement as follows: Tunnel B, 12 ft, 1 in.; tunnel D, 6 ft. 3 ins.; tunnel G, 9 ft. 7 ins.; tunnel I, 5 ft.

There were no cracks in the pavements over the tunnels at this time, so that these deflections represent the elastic actions of the slab and subgrade. This calculated daily total downward movement is based upon assumed constant difference in temperature between the top and bottom fibers of the pavement. For the variation of this tem-

*Loads heavier than these were used in special tests.

perature difference various conditions can occur. This data is submitted for the purpose of illustrating the type and magnitude of actions that exist in the edges of pavements under traffic conditions.

The amount that the subgrade contributed toward temperature deflections is uncertain, due to the possibility of a loose fitting of the plates on the upper ends of the soil rods, which condition was found in a few instances. But the soil deflection readings uniformly indicated that such deflections rarely extended from the loaded edge beyond rods No. 5.

The repairs between January and June included two new sections each 30 ft. in length, over tunnels B and I, in which the soil rods were placed so that there would be no question as to the reliability of their action. The subsequent deflections of both soil and pavements showed that soil rods No. 5 did not register deflections. The elastic action of the subgrade was apparent in all soil-rod observations. Whether soil return from a deflected position follows the same law as that indicated by the pavement rods is not known.

Under the concentrated traffic in this test, there is no question that the slab recovery between loadings was considerably less than complete. Investigations showed that hours were required before the pavement and subgrade returned to normal position from their strained condition. Whether the successive deflections from the normal position due to the application of loads at very short intervals were increased beyond the original deflection due to the first applied load was not determined. These subsequent deflections could not have been less than the initial deflection and if they were greater this fact may influence the breaking of pavements of uniform thicknesses at the edges. Such action would doubtless be most pronounced at the corners and edges where transverse cracks have occurred since those portions are weakest. With a faulty subgrade there is doubtless increased deflection. In some of the cases deflections appear to increase as the traffic test progressed. In interpreting these cases care must be taken to include influences of cracks, temperature changes and loading.

The night and early morning period,

COMPARATIVE PAVEMENT RATINGS, JUNE 30, 1922. TRAFFIC OVER TEST HIGHWAY TO JUNE 30, 6,914,850 TONS

Section	Cubic Yards of concrete per mile as actually laid	Tons of steel per mile	Total broken areas in square feet per square yard of pavement	Total lineal feet of cracks per square yard of pavement	Computed original cost per mile of pavement only	Theoretical maintenance cost per mile	Percentage of failure	Total computed cost maintenance plus original cost per mile	Unit comparison of total computed cost per mile
J	2,110	....	0.07	1.44	$31,439	$ 885	2.8	$32,324	$1.000
D	1,845	55	0.36	2.01	33,271	4,205	12.6	37,476	1.159
C	1,798	55	0.45	2.56	32,549	5,152	15.8	37,701	1.666
K	1,722	69	0.53	2.66	32,643	6,049	18.5	38,692	1.197
F	2,719	....	0.00	1.11	39,426	117	0.3	39,543	1.223
M	2,574	....	0.22	0.70	37,323	2,810	7.5	40,133	1.242
E	2,806	....	0.00	0.60	40,687	63	0.2	40,750	1.261
G	2,127	69	0.56	2.04	37,902	7,291	19.2	45,193	1.398
L	1,740	55	1.56	2.29	31,659	16,705	52.8	48,364	1.496
B	1,590	20	2.99	3.91	26,207	26,534	100.0	52,741	1.632
H	1,760	24	3.09	3.91	29,176	30,464	100.0	59,640	1.845
I	1,953	24	3.12	3.01	32,139	33,743	100.0	65,882	2.038
A	1,834	20	4.08	3.74	35,427	48,576	100.0	84,003	2.599

(a) All pavements 18 ft. wide.

(b) Estimated Cost—

Unit costs of plain concrete as follows:

From 1,001 cu. yds. to 1,500 cu. yds. per mile, $15.75 per cu. yd.
From 1,501 cu. yds. to 2,000 cu. yds. per mile, 15.35 per cu. yd.
From 2,001 cu. yds. to 2,500 cu. yds. per mile, 14.90 per cu. yd.
From 2,501 cu. yds. to 3,000 cu. yds. per mile, 14.50 per cu. yd.

Cost of reinforcing steel, $90 per ton in place.

Cost of rock ballast under Section A, $5,475 per mile.

(c) Cost of maintenance of cracks assumed equal to 1 ct. per lineal foot. Unit maintenance costs of broken areas are assumed to be three times the original unit cost of the pavement only.

(d) Percentage of failure determined from ratio of sum of maintenance cost to original cost. Those cases where maintenance cost exceeded original cost, percentage of failure is 100.

from 9 p. m. to 7 a. m. showed deflections of the edges greatly increased over those caused by day travel, since prevailing lower temperatures raised the edges of the pavement from the subgrade.

The condition of the track at the end of June was good, due to the increased care given it during the June period. However, throughout the test all sections were treated alike with respect to maintenance.

The ratings of the 13 types of pavements have been indicated on several bases, including estimated construction cost. (See accompanying table.)

The expense of tarring cracks was assumed in all cases as 1 ct. per lineal foot; the cost of making patches was estimated at three times as much as the original pavement cost per unit of area. In this table in the column, "Maintenance Cost Per Mile," it will be noted that section M shows a very much larger maintenance cost than Sections E and F. This is explained by the fact that, although Section M had two large corner breaks, they were caused by the impact of traffic from a break in the adjacent Section A. This condition was general in all sections that had broken areas. The exact area of breaks in each section, resulting from the above cause, was difficult to estimate; therefore, the entire broken area in each is considered in compiling this table. By this method a pavement that had involved a maintenance expense that was equal to its original cost would be rated as a total failure even though some portions of it were still in use. This table shows that percentage of failures do not necessarily indicate the most economical pavement. Section J is a type of pavement in use by Maricopa County, Arizona, at the time this test was planned and it was included at the request of the officials of that county. The design was previously used, however, by the California State Commission and was first built by them. Submerged curbs were, however, used in Wayne County, Michigan, in 1910.

It is probable that the same amount of concrete required for this section, if laid in the form of the usual flat pavement, would have given less satisfactory results. Doubtless this section transmits loads advantageously to the subgrade. No section of this type contained reinforcing, so that data is lacking to decide whether it would prove beneficial or not. The weaknesses that Section J developed were not characteristic of those reinforced sections and defects of the reinforced sections did not markedly appear in J, for the longitudinal cracks of J were not characteristic of the other sections where transverse reinforcing was present. The strength of the edges of the reinforced types was manifestly inferior to that of Section J. It remains for a future test to prove whether reinforcing will be as beneficial to this design as it was to the sections of uniform thickness.

A direct comparison of plain and reinforced pavements of equal thickness is not established but in relative values computed for B and K is an indication of the effect of increasing the reinforcing and placing so as best to resist tension stresses. For this comparison, Section B should be considered as a plain type so far as flexure is concerned, for the steel contained in it was placed in the middle of the pavement and therefore could be of no value in flexure until the concrete had cracked. Immediately after cracking under this condition, it has a strength as a reinforced member equal to 40 per cent of the original section on the basis of 350 lbs. per sq. in. as the modulus of rupture of the concrete and 32,000 lbs. per sq. in. as the elastic limit of the steel used in this pavement. In the case of the reversal of moment which the deflection observations clearly show exist, the compression and tension areas are interchanged, resulting in a pavement cracked its full depth. The steel, due to being placed in the center, was unable to offer any resistance to the formation of these cracks.

Section A was built like Section B, but rested on a different (broken stone) foundation and this foundation of Section A is considered largely responsible for its early failure. It was the only section in which breaks started in the middle. In all the other sections, all of the breaks started at the corners, ends and edges. While Sections H and I are of the same thickness and contain nearly the same amount of steel as Section A, both have longitudinal joints in the middle and Section I has an edge curb in addition.

In computing the table the actual thickness of the concrete as found from the cores removed and by measurements

on braking up the slabs in February, 1923, was used throughout.

Transverse Cracks

Vertical temperature deflections of the edges of Section D show that they moved in a wavelike manner. This is attributable to two causes which may in some degree act independently but under most conditions are jointly present. One of these conditions is the unequal expansion of the extreme fibers of the concrete because of their difference in temperature. The other is the existence of an axial stress caused by the longitudinal expansion of the entire section and the frictional resistance of the subgrade at the bearing points. A third condition which is induced by these two is one of flexure.

The stress in the concrete will be a maximum under a combined action of the axial and flexural forces. The ratio in which these two forces act can not be stated, but in many cases the flexural forces may be suspected of being the predominating factors.

Effect of Traffic on Corners of Plain and Reinforced Concrete

The action of those corners of reinforced sections that broke, due to traffic, is particularly worthy of note. Since the steel added a very small value to the flexural resistance of the concrete before cracks appeared, as in all reinforced concrete construction, it was only after a crack developed that the steel could function as intended. The increased traffic that was carried by a cracked reinforced corner compared to a cracked plain concrete corner was very marked. Whereas the plain concrete corner continued to disintegrate under repeated applications of load until completely gone, the elastic properties of the steel so supported the reinforced corner that disintegration was considerably retarded. The corner referred to sustained 46,500 applications of truck loads of 23,800 lbs. from the time it cracked to the end of the traffic test. This was a corner of the repair section 30 ft. long, placed over Tunnel B during the suspension of traffic. This section is shaped similar to Section J but is a 5-in. pavement, thickened to 8 ins. at the edges. All reinforcing bars were ⅜ in. Round corrugated and transverse bars were placed on the top at 9-in. centers and on the bottom at 12-in. centers. Two bars on top and two on the bottom were placed longitudinally along each edge of the pavement. The corners were additionally strengthened by three short longitudinal bars at the edges, and by two transverse bars, all in the top of the pavement.

The foregoing article by Mr. Aldrich was written out for "Municipal and County Engineering," and was based on an impromptu talk before the recent annual meeting of the League of California Municipalities.

DESIGN OF CAR TRACK FOR PAVED STREETS AND MAINTENANCE OF THE PAVEMENT

By Howard H. George, Engineer Maintenance of Way, Public Service Railway Co. of New Jersey, Newark, N. J.

Engineers will acknowledge the impracticability of preparing a definite specification for street railway track construction which would be suitable for all possible conditions. Neither is it desirable to set up one, two or three types as standard and say to the railway industry: "Use this type here, or that type there." Such a specification or standard design would work an unnecessary financial hardship on a large percentage of street railway companies, and would probably not give the best results to a great many others who were financially able to build in accordance with it. And not only must economy in first cost be considered, but economy in subsequent maintenance as well. And, last, there is still the fact to face that track wears out and must be completely rebuilt and it should be so designed in the first place as to permit the maximum amount of salvage at the time of reconstruction. This feature is equally desirable in the case of pavement. This is an item which is apt to be frequently disturbed during the life of a track, and the cheapest in first cost is often the most expensive in the long run.

Standard specifications for the miscellaneous materials entering into a track can and should be prepared, but to say that any given combination will result in the best track for all conditions would be about as ridiculous as to say that there is one best automobile or one best anything else that is manufactured by assembling a number of different units together. The experience of others is a good guide as to what may be expected from any particular type of construction, but this experience should be determined from careful personal observation and not from camouflaged reports.

Factors to Consider

Street railway engineers are confronted with a very large and important problem in the determination of the type of track construction most suitable for the conditions on their property. Several factors enter largely into this question. Probably the first is the maximum weight and type of equipment to be operated and volume of traffic to be carried.

The next factor is that of the condition of the soil on which the track must be placed, and its ability to support the loads. This subject, together with that of the actual stresses existing in the track, is one to which, unfortunately, too little attention has been paid in many cases in the past, and has undoubtedly been responsible for many cases of failure of the track structure and consequently of the paving. Soil which, under ordinary or natural conditions, would be entirely unsuitable for supporting any kind of track structure, may be made entirely satisfactory in several different ways. It may be accomplished by the use of cinders or other light, porous material rolled into the soil so as to form a binder. Sometimes crushed stone or slag will best answer this purpose, and in the latter case it may be that the run of the crusher will accomplish the best results rather than the use of a uniformly graded ballast. Then again, conditions may be such that drainage of some kind or another should be resorted to. The existence of storm water sewers in the streets has, in many cases, a very large effect on the condition of the sub-surface soil.

The last important factor is that of economy, and it is in meeting this requirement that the engineer is called upon to exercise his greatest ingenuity and is largely responsible for the many different details of track construction in use by electric railway companies in this country today. One engineer will advocate stone ballast. According to his idea 6 ins. of such ballast should be placed under the ties. Another engineer, while agreeing that stone ballast is the proper material to use, will say that 4 ins. under the ties is sufficient. Still another engineer will say that just as satisfactory results are obtained by the use of gravel, crushed slag, or perhaps cinders for this purpose. Probably all three are obtaining satisfactory results, and it is here that local conditions play a very important part. In one locality crushed stone may be scarce, it may have to be hauled a long distance, while gravel is obtainable locally at a low cost. In the other case, it may be that good cinders are obtainable, whereas neither stone nor gravel are to be had at a reasonable cost. Or it may be that the natural soil condition is such as to make it unnecessary to use any other than the natural soil for ballast.

In the matter of ties, some engineers specify white oak ties because they can still obtain them locally, or within a reasonable distance of their property. But it would be out of the question to require every property to use white oak for this purpose, for it could not be obtained in sufficient quantities at any price. There are plenty of other woods which answer the same purpose for electric railway track conditions equally as well at considerably less cost. Many otherwise inferior classes of woods are made entirely suitable for railway ties by the use of a proper preservative treatment.

The use of tie plates may or may not be necessary or desirable. This depends entirely on the weight to be carried by each tie, and the compressive strength of the wood at right angles to the fiber. If the rail base and the tie at the rail bearing point are wide enough to provide a bearing area sufficient to keep the unit compressive stresses within the proper working limits and prevent excessive cutting during the life of the tie, then tie plates are not necessary, and their use adds nothing to the life of the track and only serves to increase its cost.

As to the question of rails and joints, we are again confronted with a large assortment from which to choose. Heinz with his "57 Varieties" has nothing on us when it comes to selecting a rail, and the worst of all is the fact that the rail manufacturers are apparently willing to continue to make new sections as often as a railway company with sufficient influence makes a request for one, sometimes making that company pay for the cost of the new rolls, and sometimes absorbing this cost in its general manufacturing overhead. In many cases the differences between rails are so slight as to be hardly noticeable. Here again weight of equipment, volume of traffic, design of wheel treads and flanges, as well as details of the track structure must enter into the discussion. I will not attempt to express an opinion of the relative merits of the various types of

rails, either as to details of design or on what are ordinarily referred to as T-rails, as compared with what are commonly known as Girder rails, as this is a subject that would start an argument which would in itself take up more time than is available at this meeting.

It is generally admitted that street railway engineers are divided into two camps, one of which advocates a rigid track structure; that is either steel ties encased in concrete or some form of concrete beam support, while the other advocates an elastic or resilient supporting structure for their rails. While I have some very decided views on this subject, I will refrain from discussing the relative merits of the two types, for this would again open up a field for argument which has no place in a paper of this kind.

Type of Paving

A concrete pavement in a track area can be put down at a very reasonable figure, and when it is first laid it looks fine. But unfortunately rails have a peculiar habit of breaking occasionally, joints go bad and the concrete has to be taken up in order to make the necessary repairs, and it is almost impossible to make an entirely satisfactory repair job on concrete paving. In addition, when the time comes to entirely rebuild the track, the salvage on the paving is practically nothing.

Brick and wood block pavements both have found considerable use in track areas, but while more economical in first cost than granite, and although under some conditions giving satisfactory results, in the majority of cases they are not the most satisfactory pavements for track areas, and economy in first cost is very often responsible for subsequent expensive paving maintenance and practically no salvage value at the time it becomes necessary to entirely rebuild. The same statement is true for asphalt paving, and especially where the asphalt has been laid in direct contact with the rails. Experience has shown that, where asphalt paving is laid in the track area, at least one and preferably two or more rows of stone block should be laid on each side of the rail. There is always some vibration of the rail and where the asphalt is laid in direct contact with the rail this vibration opens up a small joint between the rail and the asphalt into which water penetrates and the action of the vehicular wheel loads on the pavement at this point soon disintegrates the asphalt immediately adjoining the rail.

Stone block pavement on the other hand, while costing more in the first place, lends itself readily to repairs, has a long useful life under the most severe traffic conditions, and after years of service can generally be reclipped and relaid at a relatively small cost and gives a pavement as good as new. As a matter of fact old blocks which have been reclipped should make a better wearing and more dependable pavement than new block, because of their previous long exposure to the weather, and the fact that in this way all soft stone has been eliminated.

Effect of the Other Utilities on Track Maintenance Problems

If no other utilities occupied the streets the problem of track and paving maintenance would be much simplified. The problem of the location of the various utilities in the public streets becomes more complicated every year, not only to the municipal engineer but those of the utilities as well. The street railway, as one of the utilities, is the only one which occupies the surface of the street. In addition to the street railway there are no less than six other utilities which may occupy the streets in some manner.

We have sewers, water, electricity, gas, telephone, steam mains and sometimes mail tubes, all of which occupy more or less space and require frequent service connections to the adjacent structures along the street. Some streets also carry exceedingly large trunk sewers and water mains which are frequently independent of the regular local mains. Practically all of these utilities have manholes and valve boxes which extend to the surface at frequent intervals and these often form quite a collection at street intersections. Instances have been noted of as many as eleven manhole covers at one location within the confines of two 50 ft. intersecting streets. When there are many manhole heads in the vicinity of the car track, curves and special trackwork, it becomes a nice problem to design tracks to dodge them, and their presence usually causes great difficulty in properly constructing and maintaining the tracks and track pavement.

There is a need for closer co-operation among municipal and utility engineers in relation to matters of location, and many cities are finding it very desirable to set up bureaus charged with the design and location of sub-surface structures.

The construction of sub-surface utilities prior to the construction of street railway tracks of a permanent character is greatly to be desired, and until the streets are properly graded, curbed, paved and have all their normal underground sub-surface mains in place, it is not desirable to attempt to construct tracks of a permanent nature. The sidewalk spaces might be more generally used for locating many utilities, although in some places there may be objections from a legal viewpoint relating to the use and occupancy of such spaces. And, of course, vaults under the sidewalks occasionally cause some trouble. My understanding, however, is that there are no legal objections to utilizing sub-sidewalk space for utilities, whatever personal objections property owners may have. Also in most places vaults under sidewalks are illegally located, even though tolerated by complaisant officials. On new streets these objections would not obtain to a very great extent. No attempt has been made to consider what may be the best location for all of the sub-surface utilities. They are mentioned because the subject seems to call for their discussion, and when we see the complicated installations of pipes and conduits in some of the streets of our large cities, we are forced to conclude that much of the confusion could have been avoided if early attention had been given to their proper location.

The central location of tracks in streets is considered by all competent authorities to be the best for cities. Such a location is the most logical, convenient and safest for the public. Where possible, on wide thoroughfares, there are good reasons for considering the use of parked spaces for the tracks. Such spaces or areas are safer for all other forms of street traffic and for car passengers. Better car schedules can be maintained due to less interference from vehicular traffic, and parked areas are more quiet, as there are no pavements acting as sounding boards. Also the tracks are cleaner, thus lessening noise due to wheels passing over grit on the rails. The railways can more economically maintain the parked strip and the tendency to neglect such track in times of stress is much less than where pavements must be opened in order to make track repairs. Probably four times as much effective track work can be done in parked areas, as compared with paved areas, for an equal expense.

One of the most frequent sources of trouble with tracks in central locations comes from disturbances of the sub-grade which are due to settlements over cross trenches made for service connections or for additional mains of one kind or another. The railway has had little or no control over such trenches and until the present time it has been difficult to convince municipal highway engineers of the importance of special inspection of all such openings, not only during the work, but also during the restoration of backfill and to prevent undue haste in repaving.

This matter, of course, is not directly concerned with the location of the utilites as a part of the original design, but it is to be considered in respect to the street railway as a located utility, upon which, at present, is placed the burden of care and maintenance, not only of tracks but also of the pavement, wherein this utility distinctly differs from all others occupying our streets. No other utility is obliged to install and maintain pavements for others to use. Any undue influence causing unwarranted expense to the railway in such circumstances should have our attention, and the co-operation of municipal and utility engineers is of vital importance in lessening the trouble incidental to poor track and pavement conditions which are all too frequently caused by outside influences, entirely beyond the control of the railway.

Responsibility for Paving and Its Maintenance

A paper of this character can hardly be considered complete without some discussion of the very important subject of responsibility for paving and maintenance of the same in railway tracks in city streets. What should be the responsibility of the street railway company with respect to the cost of installation and maintenance of pavement? Payment annually of large sums by street railway companies for pavements and their maintenance secures nothing of value to the utilities. The materials which go into pavements are really purchased by the railway company and turned over to the municipality for the benefit of the community at large. The railway company derives no special or peculiar benefit from the construction of the pavement. On the contrary, it is a burden rather than a benefit. This principle has been established by no less an authority than the Court of Errors and Appeals of the State of New York. The duty to pave and maintain the paving of the so-called track area is imposed for the pecuniary benefit of the municipality.

It is not dependent upon conditions that the street railway creates, such as the interference with the surface of the highway due to the presence of the track in the street.

The obligation to pave and maintain the pavement in the tracks is a relic of horse car days. In the old days when all the cars were drawn by mules or horses, the paving charge or tax levied on the street railway was admittedly a fair and equitable assessment. Undoubtedly the horses pounding on the narrow strip between the rails, day in and day out, all the year round, did wear the pavement and the street car operator of those days probably acknowledged the responsibility readily enough, but those days have long since passed. With modern track construction and electrically operated cars, the damage done to the pavement from the operation of cars is relatively small, and in any event, is limited to the pavement immediately adjoining the rails. This fact has been recognized in the State of Connecticut, where the paving burden has been materially reduced by limiting the responsibility of the railway companies to a width of 8 ins. on either side of the rail. Street car loads are carried down to a substantial bearing area over the sub-soil through the rails, ties and ballast, and not through the pavement. With modern rail joints the pounding of the cars over loose joints has been practically eliminated. What then is the principal cause of paving damage?

I was very much interested in reading the editorial review in the Engineering News-Record of May 10, 1923, on the subject of damage to pavement by automobile trucks. A survey of 20 large cities throughout the United States showed that trucks weighing, with their loads, from 15 to 25 tons are not uncommon, and such loads, operating over paving at relatively high speeds, are the cause of most of the cases of pavement failures, sometimes even breaking through the concrete paving foundation. A truck load of even 20 tons distributed over four wheels gives a wheel concentration heavier than will be found on almost any ordinary 8-wheel trolley car. Tests of impact stresses conducted recently by a committee of the American Society of Civil Engineers show that these are actually much higher than for electric railway cars. The conclusion reached in the Engineering News-Record survey was that the pavements generally as constructed in the last ten years will break down comparatively rapidly under the extreme truck loads of 15 to 25 tons which now prevail to some extent in most large cities. I personally know that we have such loads in New Jersey, for I have had occasion to check total weights of trucks operating over our ferry between Edgewater and New York City, and have found weights on four-wheels as high as 23 tons.

Paving Costs Considered as Tax

It is a notorious fact that the electric railways are the most heavily taxed industry. Statistics show that if you add up all the taxes, state and local, for the steam railroads in the State of New York, these companies pay about 27.3 per cent of their net profits in regular taxes. The electric railways, 44.4 per cent, telephone and telegraph, 16.2 per cent, and gas and electric, 23 per cent. Referring to Virginia, for instance, in 1921 the electric railways paid in taxes 36.6 per cent of their total net revenue, an increase of over 100 per cent since 1917 when they paid 13.61 per cent, and these figures do not include any federal taxes. Our American Electric Railway Engineering Association statistics show that, taking the country at large, about 6.5 per cent of all our gross operating revenue goes into taxes and about 3.5 per cent into paving and similar charges, a total of about 10 per cent of the gross operating revenue for taxes. This represents approximately one-half cent of the fare paid per passenger. And this fact must be remembered, the rider pays the paving bill, whether it is in the form of increased fare or increased municipal taxes.

Increase in Paving Burden Since the Beginning of Electrification of Street Car Lines

Comparable figures on the mileage of electric railways then and now show that in 1890, when the electrification of lines was just getting under way, there were about 8,123 miles of single track operated by street railway companies. In 1917, according to the United States Census, there were 44,835 miles. Although the only justifiable basis for the imposition of the paving impost disappeared with the horse cars, the companies today pave and maintain a right-of-way more than five times as long merely because, when the change was made from the horse-drawn vehicles to electrical propulsion, no consideration was given to changed conditions as far as the resultant wear on pavement was con-

cerned. As the street railway companies extended their lines the paving burden became proportionately heavier, for of course the outlying lines did not pay as well as those of the thickly populated towns, while the cost of paving increased more or less uniformly throughout the system. Nor is this the whole story. The type of pavement used at the time these paving taxes were imposed was usually nothing more than a rough gravel, cobble stone or macadam paving, comparatively inexpensive types as compared with those required to meet the demands of modern heavy vehicular traffic. Thus the process of piling up the burden on the street railway company is still going on. A conservative estimate of the total amount expended each year for paving by street railway companies is about $22,000,000, of which about $15,000,000 is for construction and about $7,000,000 for maintenance. This is slightly less than 25 per cent of the estimated total net income of the industry in 1921. In other words, if the industry could be relieved of these obsolete imposts it would mean an increase of approximately 25 per cent in their net income, and would also mean a healthier condition of the traction systems, and greater ability to maintain their lines in condition to meet increased demands upon them.

Street railway fares are not readily susceptible to changes from time to time. Only under the stress of extraordinary circumstances are increases in fares granted. Periodical variations in the rate of fare merely to cover taxation would not be tolerated by the public. If the private merchant finds that the selling price of his various wares is not sufficient to meet the needs of his business there is nothing to prevent his increasing the sale price to meet the requirements, but this is not so easy with a utility like a street railway company. With the merchant an increase of a cent on each article sold may produce the necessary additional revenue, and this is usually a small percentage of the total cost of the article, but in the case of a car ride an additional one cent, which is the smallest unit of our monetary system, added to the rate of fare means anywhere from 10 to 20 per cent increase.

Relief From Paving Obligations

The question of relief from the paving burden is a vital one to the street railway industry. Relief has been granted in a certain relatively small number of cases through special legislation. A good beginning has been made and the sentiment for complete relief is gaining ground among thoughtful people. It would appear to be high time that laws making burdensome paving requirements on the street railway companies should be repealed and the justice of the street railway's claim for relief from the responsibility for paving expense recognized, and this burden placed where it properly belongs.

The foregoing matter is from a paper presented by Mr. George before the State Engineers' Section of the Conference of Mayors and Other City Officials held at Buffalo, N. Y., June 13, 1923.

SOME VICISSITUDES OF A MUNICIPAL ENGINEER

By John F. Druar, of Druar & Milinowski, Consulting Engineers, Globe Bldg., St. Paul, Minn.

The ordinary university course in engineering is too narrow in its teachings and there is not enough elective work to open a student's eyes to the world. One goes in, takes a prescribed course and passes out to some job. Perhaps he likes it and perhaps he does not. At any rate, he is seldom up to filling the job the way it should be filled. I know I was not up to my first job and remember I once tried to get a contractor to shoot out a retaining wall and replace it because a blast had loosened the forms and allowed the wall to bulge here and there, perhaps an inch and a half in the worst places. After a talk with the contractor, who really treated me like a patient father, I no longer insisted and started to fill my job as I should fill it, learning to insist where it was essential to use my judgment in all cases and finally knew my job. Long hours and little pay was the cub engineer's lot in those days and one worked and carried the "Message to Garcia" or just quit ignominiously. I had a hard time arriving but was fortunate in working on some of the largest pieces of work in the country at that time and of having responsibility thrust upon me. I remember one occasion, being called in from an important piece of work, handed an old-fashioned 45 Colt revolver with a box of cartridges and told I was now foreman of a boiler shop, the crew of which had struck. They handed me a gang, or rather a mob, of foreigners and I was told to run the shop. I did not know over-much of the operation of a

boiler shop, but ran it for six weeks and could not hear normally for a year afterwards.

Trouble With Employes

Long ago we found that a municipal engineer, to be successful, must devote a great deal of his personal time to the exact planning of the work and to improvements in plan and method of carrying on the work, to the sale of his services, and reduction of costs wherever possible. We have in the past found a considerable amount of trouble with employes hired on trial who do not always carry their "Messages to Garcia." While we have tried to select the best, there has been a large, in fact too large, turnover of employes'. Many did not satisfy. They did so much and no more. They did not have the proper perspective and did not think for themselves the way they should. This is problem number one and perhaps as great as any. If I had in the past been sent two or three hundred miles to get certain information and failed to get all the information necessary for the layout of the work in question and if I could not have answered all the questions put to me I should have had a "can" attached without delay, yet in taking on men I have found too many who failed in this particular manner. The usual excuse was, "You did not tell me you wanted that." Now this failure has been so universal that there must be some fault with the college training of these men. (Where I received $1.25 per day, when I started in after my course of mechanical engineering, we now have to pay a cub $125 per month and expenses out of town). Much could be forgiven a man if he did the work after a year's apprenticeship and did not require some one to do his thinking for him, but, alas, too many do no thinking, they don't plan the direction of the work in the right way, they keep careless notes, they do not familiarize themselves with the specifications which give the contractors and engineer specific duties to perform. They use poor judgment and have not been trained to think. To be sure, we have eliminated the poor ones from our rolls in the past, but it has been a problem.

Selling Engineering Service

The next problem is that of selling our services. First, municipal work has its ups and downs, a good year and several bad ones. Suppose we visit a town once and the council decides to proceed with some work, and they sign a contract. We proceed with the work and in a year's time the work is completed, and is entirely satisfactory. Do they employ us for the next piece of work without question? No, the council may have changed, some other engineer may have come in at the psychological moment and without even asking us for an opinion or a proposition for engineering, they select some one who may be a good talker, but who combines good talking with a cut in rates and a discourse on how our fee for the work was too high. There are engineers who will cut rates to a point where there is no profit, for the sake of getting the work. How they live, we know not. We do know, however, that they cannot afford to give such service as would be a credit to the profession. (We know that the cost of the complete work often rises far above our costs for the same work, but as the work is done but once there is no chance to prove this except on comparison of the assessments or bond issues that are spread for work of the same nature).

Often we find several engineers of more or less ability, several salesmen of engineering, who go out with the avowed intention of landing the job at any percentage they can get, and often short-sighted councils will select the cheapest man. I remember one case where an engineer took a piece of work for a little fee of $100, one other set a price of $750, and several others asked prices between $1,000 and $2,000, while we and some other engineers asked 5 per cent of the cost for engineering service, which would have amounted to $3,000. The council selected the $100 man! No wonder there is an increased demand for City Managers.

Lack of Progressive Spirit

Very often we find a council recognizes the fact that sewers, water or pavement should be installed, that they personally want them, but that the citizens do not, or perhaps the banker does not, want them. It is not the proper time, prices are not right, etc. It sometimes requires a lot of patience and forebearance not to tell them what you think of non-progressiveness in this day and age. I have talked to councils about making a report with blueprints showing the people where the mains will be laid, the cost to the property owner and other points. I have shown where the cost of water spread over a period of ten years amounts to less than 3 cts. per day for a 50 ft. lot.

I have shown that the insurance (guaranteed reduction) would pay for the improvement—all to no avail. The work was put off—Why? Just because there was not one man on the council who had the initiative to make a motion that would start his town toward progress. Then I have had them make a negative motion. Of course it is not necessary to make any motion if they do not want to do anything. I explain this and several times I have asked a councilman to change his motion to a positive one, whereupon the motion carried and the work went in. I have never found a town that put in any improvements who would have returned to the old conditions. I do not like to go out and have to sell service, trying to convince a town that they must have improvements for it is a thankless task. Often it seems undignified.

Some Attractive Features

Municipal work has its attractions, however. I like the personal contact, the clash of minds and the overcoming of prejudice against improvements. I know we are helping to build communities through our efforts and that after we leave a piece of work we have accomplished something which is worth while and that we have given the people something for their money. A municipal engineer has a great deal of responsibility in his profession and if successful his influence is felt wherever he does work, for he provides the improvements which stand for the upbuilding of the community and indirectly he influences the character of the people in every town in which he does work. First, with a water system, he helps in an economic way to fight the demon fire. He gives the people the opportunity to have a pure, wholesome supply of water unlimited in quantity which, when utilized in the homes, streets and gardens gives a cleaner and healthier town. The people at once begin to take a greater pride in their surroundings and the tone of the whole town improves.

Again, it may be an electric light plant with cheap universal power which helps to build the payrolls of a town. The small town to be a success must have a live Commercial Club ever on the alert to annex some industry, creamery, mill or canning plant so that the community may have an income independent of the money spent by the farmer for clothes and supplies.

Again, with a sewer system, the disposal of wastes and cellar drainage is solved for all time. No more privies or cesspools in the back yard with the fly breeding that takes place in such surroundings. No more are the slops from the kitchen sink thrown on the door sill. Again the people are lifted out of the mire by pavements. Who but the engineer is to tell the people that in the past for makeshift roads they have spent more than they would for a permanent pavement?

Competitive Bidding of Engineers

Thus it goes, but the engineer cannot expect business in these days to roll into his office. The municipal engineer must be constantly on the go or starve. Municipalities instead of selecting an engineer on merit, in some instances advertise for engineers and have a competitive letting, selecting the cheapest engineer of the lot, regardless of the lack of experience, familiarity with the work or other requirements. The result is always poor municipal work and a black eye for the profession, unless the mistakes and high cost are not discovered because there is no chance of comparison.

The City Manager

We now have among us the City Manager who comes with the best of intentions to run the business of the municipality, not knowing quite the expectations of the Mayor, and to make himself a good fellow he decides he can do his own engineering in addition to his administrative duties that should take all his time. This does not redound to the credit of the City Manager who, if he would, could well insist on the employment of a first class consulting municipal engineer to direct the whole improvement and to furnish estimates and draw plans for the work. It is to be hoped that the City Manager may see the light in this respect and stick to his calling. We like the idea of a City Manager and if we do not have to fight him for work, which is the province of a municipal engineer, we will gladly boost for him and recommend that a Manager be employed as a Manager is what most towns need.

Worrying Through

The city or village councilmen are seldom paid enough for their services to make it an object to run for the office or to properly handle the office after being elected. They may be public spirited and have a burst of righteousness for a few meetings, then they drop into a rut and try to worry through their term, trying

not to antagonize the citizens by even suggesting any improvements. They feel that if they talk for improvements, the citizens will not patronize their places of business. No one wants to take the bull by the horns and come out for a needed improvement. I have attended meetings of citizens and councils where a citizen would get up and finally cause the council to take action, for the citizen would see the light. "If improvements are made, we will be taxed," seems to be the gist of the cry of all. The people fail to see that a tax on property for sewers or water or pavement simply reduces some cost they are standing somewhere else and to convince them of this becomes the duty of the engineer.

DISCUSSION OF CONTRACT VS. DAY LABOR SYSTEM IN THE CONSTRUCTION INDUSTRY

By Charles A. Mullen, Consulting Paving Engineer, Milton Hersey Co., Ltd., Montreal, Quebec.

(Editor's Note: This magazine favors the contract method of conducting construction operations in the field of public improvements, for reasons often stated. However, there are many who hold to the opposite view, that the day labor system is preferable, and discussion of this familiar subject from time to time is desirable. The present article, an enthusiastic statement of the advantages of day labor as they appear to the author, is from a paper presented at the Public Ownership Conference held at Toronto, Ont., Sept. 10-13, 1923, under the auspices of the Public Ownership League of America, Ontario Hydro-Electric Power Commission and the City of Toronto.)

Maj. F. S. Besson, Assistant Engineer Commissioner of the District of Columbia, has recently published a book entitled "City Pavements," which supplies me with exactly the figures I want for the purposes of illustration; but Washington might just as well be New York, or Toronto, or Buffalo, or Montreal, or Charlottetown, Prince Edward Island, as far as the general facts are concerned It would only be necessary to apply the local cost figures for labor and materials, and the rest would be about the same.

In Major Besson's estimate, after figuring the costs for materials, labor, supervision and overhead; in fact, all the knowable costs, he adds 10 per cent for contingencies and then 15 per cent for contractor's profit. Not contractor's wages, mind you, but profit; for, if the contractor has actually worked as a superintendent or manager or even president of his own corporation, he has usually not overlooked paying himself generous wages or salary for his actual sweating at the brow, and charging it in as overhead, before figuring his 15 per cent profit. That is what good business men like you and I would do were we in his place.

Between buyer and seller, fraud sticketh as mortar between bricks; at least, so says the Bible. Now for the moment, let us assume that the Bible is wrong in this statement, and that both the contractor and the city officials are strictly honest, which I believe is often the case. Then the difference between the public and the private ownership of the street paving industry of the city of Washington is the contractor's 15 per cent profit plus a large part of the 10 per cent contingency item and a very considerable part of the overhead, say at least 20 per cent in all.

Not unwisely did I select the case of the city of Washington, for few there are who will be so bold as to state that the Engineering Corps of the United States Army, which built the Panama Canal under General Goethal's public ownership after private ownership of the canal building industry at that point had failed, and to which army engineering organization Major Besson belongs, is capable of efficiently organizing and operating a publicly owned street paving industry for the city of Washington; or for the United States of North America for that matter.

Men will not work as well under public ownership of an industry as under private ownership, is an argument frequently advanced. My own experience has been to the contrary. I have been able to get the same quantity of work and of better quality from men through publicly owned industry than through private, both at times when I was in charge as a city official and more recently when, as consulting engineer, I have assisted in directing the execution of street paving programs.

High prices for materials will be paid by the publicly owned industry, is another argument frequently advanced. From my own experience I know that a public body can purchase as cheaply or more cheaply. Of course monopoly com-

binations are sometimes made against the public. Montreal was recently face to face with what seemed to be a monopoly in sand. The Administrative Commission very quickly purchased a sand pit, and today monopoly in the supply of that material is broken definitely by the public ownership of a unit of the industry sufficient to supply the City's needs.

Public ownership can, if it will employ the best managers and workmen, purchase the most suitable plant and materials, and proceed with the work precisely as does the contractor, or better; and in doing so, it eliminates not only 15 per cent profit, but the contractor's overhead cost of competition, private financing, bonding, and much of the risk. Moreover, a publicly owned industry, being based on the solid foundation of service, and having a monopoly that is both legal and just, can safely make a larger investment in plant and machinery and in the continuous services of competent men.

But public ownership will not, says a very intelligent Montreal contractor, who does not agree with me on this point, and he recites many of the ills of publicly owned industry—patronage, indolence, lack of interest on the part of some of those in charge, and so on. Well, we who constitute the public have got to see that public ownership will and that it does; if we do not, it is our own fault. Public ownership did in the case of the Panama Canal, and when we are ready for it, it will do so in other lines of work, such as the building and maintaining of roads and streets.

But once we award a contract, the contractor is entitled to every courtesy and assistance from public officials. I have never had any sympathy with the contractor-baiting engineer, who draws an agreement which he himself could not live up to were he undertaking the work directly by day labor, and then proceeds to make the life of the contractor miserable. In such instances, in fact, I have a considerable sympathy for the contractor, who, being quite human, proceeds to "do" the engineer. I have in mind such an engineer under whom I worked as a contractor, and my one regret is that the public pays the piper.

When waste and inefficiency are the order of the day under the public ownership of an industry, the political conditions are usually such that private ownership of the same industry would be both corrupt and wasteful. Under public ownership, the electorate has some chance to correct the bad management, the post office for instance, while under private ownership of the coal mines we seem to have a very hard time making corrections. Moreover, a privately owned industry that is mismanaged is usually found financing the fight to maintain the status quo with part of its ill-gotten gains.

Private ownership of industry is always wasteful from the public's point of view. There is much wasteful duplication of plant, management and financing, and where a publicly owned paving industry could afford to install very modern equipment and management, because of its monopoly, the same paving industry, owned as several units by competing contractors, each controlling only a small fraction of the work and having but a doubtful control of that, cannot afford the same general efficiency, though each unit may be quite efficient when considered separately as such.

A manager may be selected under public ownership of the road making industry; while, under private ownership of this industry, the public governing body usually has to accept whoever blows in with the lowest financially responsible bid. When a road making contract is awarded today, it is seldom an arrangement between persons, it is rather an arrangement between a public body and a bunch of money sufficient to finance the contract, and here arises an interesting point.

The cost of financing work is generally duplicated under the contract system. The contractor, in bidding, must estimate his cost of financing the job. Usually, the public funds are in the bank waiting to pay him as soon as the job is completed. The bank is paying the city anywhere from zero to three per cent interest on the money, and the contractor is borrowing the equivalent of the city money from some bank at 6 per cent plus to pay for labor and material. Under public ownership, the money is immediately paid for the labor and material, and the cost of private financing, often a very expensive item to a firm not financially strong, is entirely eliminated.

Another item of waste under the contract system of doing street paving work came to my notice very forcefully last year; the non-efficient use of the avail-

able equipment due to divided managements. It happened that, in the same month, one contractor with a plant in the north end of the city of Montreal hauled material about ten miles across town to lay it almost at the other's doorstep, while the second contractor hauled identical material from the west of the city to the north. Ninety per cent of this hauling was waste.

No contract and specifications, in the way they are known to the contract system, are necessary in a privately owned industry. This does not mean that plans and requirements are not necessary; but what is needed is drawings with sufficiently clear explanations or descriptions. A city engineer in this very province not long ago told me the cost to him of building cement sidewalks and curbs by day labor. It seemed rather low, and I asked him for the specifications. He told me that he had none, and did not need them; but he showed me his drawings and sketches with explanatory statements on them. His reply was: "We have the accounts of material and labor, and, as far as the dimensions are concerned, you can go out and measure the job." This man's work is notoriously good, so I did not bother making further investigations.

There will be no law suit between the city and the contractor on this work—because there is no contractor, and it takes two to make a quarrel. Neither will there be any extravagant claims for extras. The publicly owned industry builds for use, not for profit; while the contract industry builds for profit first, that is its motivating power. Public ownership accounts are usually open for all to see—that is as it should be; but private industry is usually very jealous of its records.

I usually have to explain that I am not an unfriendly critic to contractors; what I do criticise is the contract system as such. Contractors are men just like us, not much different; and, as long as we indulge our indolence to the extent of employing the contract system in our industry, the contractor is entitled to his 10 or 15 per cent profit, or whatever legitimate competition will give him. It is our fault if we pay this extra amount in order to get our work done in this manner.

The contract system lends itself to much abuse. So far, we have been discussing the contractor who is rated as an honest man, as honest as we are; but, unfortunately, the business lends itself to some very shady transactions. We have our patented pavement monopolies, and our material monopolies, and we sometimes have arrangements among contractors by which they eliminate the competitive element and arrange their prices to suit themselves. Moreover, the politico-contracting ring is ever with us, and the concessions in exchange for contributions are only too well known.

One government chases the other out of office by pointing to its questionable practices in connection with road contract work; only, as a rule, to substitute equally questionable practices of its own. The criticism of the last Ontario governments' road practices had much to do with its defeat; and what old state of the Union has not had its investigations and upheavals from the same causes?

Public ownership does not bribe public bodies. Did you ever hear of a municipal electric light plant or any other municipal industry trying to bribe the city council or offering any party a campaign fund? A small contribution from the individuals of such an industry levied by the party in power is about the limit. Have you ever heard of the bribery and corruption in connection with street railway franchises or street paving contracts? I do not need to ask the answers to these questions. An incorrect system produces undesirable results, and private ownership of industry has about thoroughly proven itself incorrect. Human nature cannot stand it.

The Hydro-Electric Commission of the Province of Ontario is in a fair way to solving its problem, despite poor old human nature. My own view is that we need many other such commissions, and one of them should be a road and street making commission that would have its organizations centrally located throughout the Province to serve both its own needs for provincial highways, county needs where such are required, and municipal needs as well. There should be an Ontario road making and paving industry, "dirt" contractors eliminated as such and hired as managers where competent ones will accept employment.

As a matter of expediency, public ownership cannot be profitably installed unless the public body or federation of public bodies can command and use the output of an economical unit of the industry involved. A very small town cannot afford to purchase a portable paving plant

to use but once or twice in ten years; though the county in which it is situated might advisedly purchase such a plant and perform the work for its several towns; or, a province might own a number of plants, and operate them for provincial highways and village and city streets as well.

As a matter of necessity, Charlottetown, Prince Edward Island, decided to own its street paving industry. It was so far away from the usual contracting centers for this work that no contractor seemed anxious to go there and pave its streets at a reasonable price. Charlottetown purchased its municipal grading equipment, its municipal concrete mixers and its municipal asphalt plant, secured the few expert men necessary, and proceeded to do the work itself. We have yet to hear of a city, even better situated, which has done better for itself through the contract system than conservative little Charlottetown has done through the public ownership of its own street paving industry.

A matter of good business, the Charlottetown taxpayers and public officials would tell you; as they compare the costs under their publicly owned street paving industry with those under the contract system of surrounding towns and larger cities that may try to look upon them as provincials. It is good business for the public, conducted by a good business administration; not good business for the contractors who might have been adding very much to the cost of this work with no increase in its quality. Should you tell a native of conservative Charlottetown that his city had done anything radical, he would laugh at you.

"Business—Ancient and Modern," is the title of a pamphlet that I recently received from Mr. J. C. Trautwine, Junior, the man who edits the Civil Engineers' Handbook that we all know so well. In this article, Mr. Trautwine points to private ownership as the ancient and to public ownership as the modern method of handling community business; and shows the really rapid acceleration, as viewed by Father Time, of the change from one of the other that to some of us seems so slow when measured in terms of our own day and generation.

In the Province of Ontario the change from the ancient to the modern is going on apace. Behold the Ontario Hydro-Electric. Behold the Toronto Street Railway. Behold Toronto, Hamilton, London, Saint Catherines, Brantford and other Ontario municipalities owning their own paving plants and building and repairing their own streets. What is needed next, it seems to me, is an Ontario Road and Street Building and Maintenance Commission which will co-ordinate the public ownership work already done along this line and rapidly extend it.

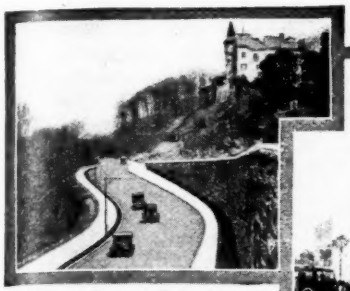
To summarize the situation, it may be said that a publicly owned street and road making industry will have at least the following advantages to the public over a privately owned industry:

1. Contractor's profit is eliminated.
2. Cost of competition is eliminated.
3. Overlapping of work is eliminated.
4. Duplicate financing is eliminated.
5. Cost of litigation is eliminated.
6. Bribery and corruption are eliminated.
7. The risk or contingency item is reduced.
8. The overhead charges are reduced.
9. More modern equipment is practicable.
10. Suitable managers can be secured.
11. The motivating force is use.
12. The profit is the public's.

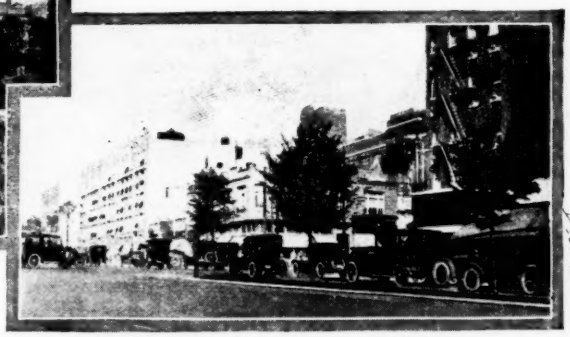
As a concluding statement, I shall merely quote the words of Major-General George W. Goethals, after he had completed the Panama Canal by direct labor, without the assistance of the contract system. He said: "I would do it all over again the same way." And one of the contractors who had bid on the work, afterwards declared frankly that it was being done more cheaply and more expeditiously than would have been possible under the contract system. If the publicly owned canal industry could succeed so well, why do we still believe that the contract system of privately owned industry is necessary or advantageous to the public in our road and street making industry?

A STUDY OF TRUCK OPERATING COSTS

Motor truck transportation has had a remarkable development in this country, particularly in the last five years. Twenty years ago there were no motor trucks while today there are more than 1,000,000 registered in the United States. Motor truck routes are being established all over the country varying from one truck to large fleet operations, and both the



Beautiful Riverside Drive, New York City, Tarvia since 1914.



Typical traffic on the Grand Concourse and Boulevard, New York City, Tarvia since 1911.

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In New York City, street construction and street maintenance are problems of tremendous difficulty. For New York's Bureau of Highways has to cope with the ceaseless, grinding traffic of more than 400,000 automobiles and 60,000 horse-drawn vehicles.

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But, not only in New York, in thousands of other cities and towns, Tarvia is solving the good roads problem. For Tarvia roads are firm and smooth, mudless and dustless at every season of the year. Furthermore, they are far less costly to build and maintain than any other type of modern highway. Tarvia insures the most miles of good roads that can possibly be built and maintained with the road funds available.

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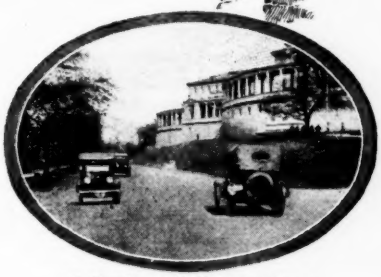

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West 183rd St., N. Y. C. A Tarvia street since 1912

75th St., New York City. A Tarvia street since 1912

passenger and freight traffic is increasing very rapidly.

As millions of dollars are invested in the truck transportation business and the organization of this business is quite well systematized, it would naturally be expected that very complete and accurate data covering costs of various types of truck transportation would be available. On the contrary very little dependable data of this kind is to be found. Many truck operators are keeping "so-called costs" but a careful investigation of their cost systems reveals the fact that they are overlooking such important items as "overhead," "interest," "depreciation," "garage rental" and other items that must be included in any accurate cost system. Consequently many of the low cost bubbles can be punctured easily by a careful investigation of the system used in arriving at the operating costs.

There are many truck users who maintain very complete cost systems on every other branch of their business except their trucking. Many fleet operators determine their truck operating costs simply by subtracting the yearly expenses from the yearly receipts of the business. On such a system apparent profits frequently cover business conducted at actual loss.

At the suggestion of Dean A. A. Potter, of the Schools of Engineering, of Purdue University, Ben H. Petty, Assistant Professor of Highway Engineering, in November, 1921 undertook a survey of truck operating costs in Indiana, and the investigation has been carried on intermittently since that time. Bulletin No. 10 of the Purdue Engineering Experiment Station, Lafayette, Ind., issued by Prof. Petty in February, 1923, is a report on the results secured in the investigation to that date, and also includes a simple presentation as to how and why a truck operator should record operating cost data. The survey is being continued and additional data will be published when available. Effort will be made to secure comparative cost data on all sizes of trucks in various classes of service over different types of roads.

Professor Petty's introductory remarks are here reproduced:

"Motor truck transportation is a business that is becoming firmly established in spite of the many failures experienced in the past. The economy of the motor truck in handling short haul freight shipments has been clearly demonstrated in numerous cases. Several railroad companies in the New England States, for example, have installed their own motor truck lines to handle all freight shipments under the 50 mile limit. The establishment of new trucking lines and the extension of their radius of operations depends to a great extent on the extension of hard surfaced roads from city to city.

"In considering this extension of motor truck activities it must be borne in mind that, like any other form of transportation, it has distinct fields of economic usefulness. Whether the operator entering one of these fields will prove successful depends largely on how carefully he analyzes his business through the medium of adequate, accurate and complete cost records.

"During this rapid development of motor truck transportation, there have been numerous failures, ranging from the one truck operator to the large fleet owner. It is probably safe to say that at least nine-tenths of these failures were due primarily to a lack of knowledge of the actual cost of operating the trucks, rates having been established in a haphazard way based principally on guess work. Scores of trucks have been returned to the dealers during the past two years by disillusioned operators who bought them on the installment plan expecting to pile up a large bank balance in a few short months. Many of these men figured their operating costs as including only gasoline, oil, tires, repairs, etc., and neglected such items as depreciation, interest on investment, and even their own wages as driver.

"On the other hand there are numerous truck operators making fair returns from their investment due principally to accurate cost accounting. Many operators are clearing from one to three thousand dollars a year on a single truck."

AUGUST PAVING BRICK SHIPMENTS HIGHEST

Paving brick shipments for the month of August were higher than for any previous month in 1923, according to statistics issued by the National Paving Brick Manufacturers' Association. Reports from 67 per cent of the industry's tonnage showed that shipments were more than nine million greater for August than for July, 36,446,000 being shipped in August and 27,092,000 in July.

Contracts Awarded

ROADS AND STREETS

Ala., Montgomery—J. W. Gwinn, Hamilton Station, Birmingham, awarded contract for grading and graveling 11.32 miles Dublin-Orion Rd. on Bee Line Hwy., Montgomery Co., at $159,699.

Ark., Augusta—R. L. Gasten, A. O. U. Bldg., Little Rock, awarded contract for grading and gravel surfacing 20 mi. in Rd. Dist. 15, 14 ft., in Woodruff Co., at $194,000.

Ark., Blytheville—J. H. Rouse Constr. Co., Cape Girardeau, Mo., awarded contract by Bd. of Commrs. of Impvts. Dist. 2, for paving and constructing storm sewers at $450,000: 109,813 sq. yds. paving; 24,637 lin. ft. storm sewers.

Ark., Hamburg—W. C. McMurray and Levinson Construction Co., awarded contract for 17 miles of rd. from Montrose to Luna Landing, through Lake Village to connect both branches of Ark.-La. Hwy. with Luna Landing, at $110,000.

Ark., Pine Bluff—Bradley, Carr & Gwin, Sheridan, Ark., awarded contract by Plum Bayou Rd. Dist., Jefferson Co., at $126,766 for 20.6 miles gravel rd. from Sherrill to Fernday through Tucker; also bet. these points branching to Core and Wright places at river and Lonoke Co. line.

Cal., Fresno—Following contracts for road work awarded by Supervisors: Rte. 2, Sec. A, to 7. A. Hanrahan, $105,117—4-in. asph. conc.; Rte. 5, Sec. B, 4-in. asph. conc. pavement to Thompson Bros., at $73,421; Rte. 16, Sec. B, 5-in. asph. conc. pavement to Calif. Constr. Co., at $72,710; Rtes. 27, 28, Sec. A, 5-in. asph. conc. pavement to T. A. Hanrahan, at $53,057; Trimmer Spring Rds. to Blanco & Taylor, at $42,000; Toolhouse Rd., Thompson Bros., at $35,760.

Cal., Hermosa Beach—Geo. H. Oswald, 366 E. 58th St., awarded contract for constr. of 5½-ft. walks; Cl. A curb; 7½-ft. gutters and monuments on Summit Ave. bet. E. St. and Manhattan Ave., also portions of Manhattan Ave., at $117,205.

Cal., Los Angeles—Boulevard Land Co., 111 W. 4th St., awarded contract for impvt. of Topango Canyon Ave., bet. Ventura Blvd. and Ybarra Rd., at $224,990; Griffith Co., 502 L. A. Ry. Bldg., awarded contract for impvt. of 10th St.—Gaffey to Meyler Sts.—at $34,738.

Cal., Sacramento—Pacific States Constr. Co., San Francisco, awarded contract for constr. of section of state hwy., San Mateo Co., Div. 4, Rte. 2, Sec. A—San Bruno to San Mateo—3.4 miles; conc. shoulders, asphalt and conc. surfacing, at $270,782; Kaiser Paving Co., Oakland, contract for constr. of section of state hwy., Placer Co., Div. 3, Rte. 3, Sec. A—Roseville to Lincoln—1.2 miles; conc. shoulders and pavements, at $37,805; Irey and Holden, Lodi, contract for section of state hwy., San Joaquin Co., Div. 3, Rte. 5, Sec. A—west boundary to Banta—8.07 miles waterbound macad. shoulders, at $41,000.

Cal., San Diego—California Constr. Co., San Diego, awarded contract by Co. Supvrs., at $30,100 (using 5-in. cem. conc.) for paving 1.64 mi. in city of Escondido bet. Nutmeg and Lime Sts., 18 ft. wide; also constr. at $61,280 (same type) of 3.04 mi. county hwy. from Bernardo to Escondido, 18 ft. wide; also constriction (same type) of 8.55 mi. county hwy. from Fallbrook to San Diego-Riverside county line, 18 ft. wide, at $196,180. H. D. Churchill Co., 350 Merrick St., Los Angeles, awarded contract at $255,959 (5-in. cem. conc.) for 9.89 mi. county hwy. bet. Buena and Bonsall, 18 ft. wide.

Conn., Danbury—P. Bacco, 300 State St., Stamford, awarded contr. for paving 14,100 ft. Sugar Hollow Rd., 20 ft. to P. Bacco, State to furnish cement. Contract price $123,494.

Conn., Hartford—Following contracts let by State Hwy. Dept., at New Hartford: Nopaug Rd., 29,282 lin. ft. bitum. macadam to A. Vito Co., Thomaston, at $188,129; Farmington: 3,700 lin. ft. sheet asph. on Farmington trunk line beginning at Bird's-eye Cor. and extending to Elm Tree Inn, to Edw. Balf Co., Hartford, at $30,003, plus cement to be furnished by State; Clinton and Madison: Shore Rd., 18,191 ft. plain and rein. conc. to Conn. National Pavements, Inc., New Haven, at $159,955, plus cement, etc.; Woodbury and Beth-

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lehem: Bethlehem-Woodbury Rd., 8-in. waterbound macadam resurfacing for 6,413 ft. to Jno. DeMichiel & Brother, Torrington, at $24,$15; Kent: 18,122 lin. ft. rein. conc. on Housatonia Rd. to Osborn & Barnes Co., Danbury, at $135,252, plus cem.; Mansfield: 10,480 ft. bitum. macadam on Mansfield-Depot-Storrs Hwy. to A. Vito Co., Thomston, at $67,476; Plainville: 5,518 lin. ft. plain conc. on Cook Ave. to Osborn-Barnes Co., Danbury, at $17,-051, plus cem.; Putnam and Killingly: 13,200 lin. ft. rein. conc. on Putnam-Norwich Rd. to A. Vito Co., Thomaston, at $77,714, plus cement; Trumbull: 19,250 ft. rein. conc. on Nichols Rd. to Bridgeport Construction Co., Bridgeport, at $92,544, plus cement.

Fla., Brooksville—Broadbent & Groetting, Ocala, Fla., awarded contract by State Rd. Dept., for 9.5 miles rd. from here to Pasco Co. line, Proj. 545; sheet asph. with binder course on 8-in. rock base, at $287,790.

Fla., Pensacola—Lawrence Constr. Co., Augusta, Ga., awarded contr. by Escambia Co. Commrs. for 7 miles paving on Pensacola-Flomaton hwy., so. of Flomaton, at $209,434.

Iowa, Muscatine—S. J. Groves & Sons, 306 Globe Bldg., Minneapolis, awarded contract for grading 12 miles Grant Hwy. from Stockton to Elizabeth, Ill. (Muscatine Co.) at $100,300.

Iowa, Waterloo—J. A. Dunkel, Webster City, awarded contract for grading Primary Rd., 40 from here to Janesville; roadwork $0.275 per c. y., channel excav., $0.375. Engineer's estimate, $60,000.

Ky., Frankfort—State Hwy. Dept. let contracts for 3 road projects as follows: Larue Co., 5.409 mi. Buffalo Rd.—corp. limits to Hodgenville to Nolin River brdg.; waterbound macadam; St. Proj. 41, Sec. A, F. A. P. 107, to McClellan & Campbell, Bowling Green, Ky., at $113,703; R. B. Taylor Co., Louisville, Ky., at $8,016, for oil surf. treat.; Shelby Co., grade and drain 485 ft. Frankfort Rd., Midland Trail, 6 miles east of Shelbyville, St. Proj. 17, Sec. C, to Monahan & Turner, Lexington, Ky., at $4,274; Pendleton Co. to Broaddus & Forbes, Richmond, Ky., at $14,960, to furnish 8,000 tons crushed limestone for 7 mi. Falmouth-Covington Rd. from jct. of Williamstown Rd. St. Proj. 62, Sec. C and 21-C-1.

La., Baton Rouge—State Hwy. Comn. let contract for graveling 9 miles Abbeville-Jennings Hwy., Vermillion Parish, to Martin & Cody, Lake Charles, at $87,173; also 9 miles Burnside-Hope Villa hwy., Ascension Parish, to Banta & Hutersbaugh, Lake Charles, at $59,168.

Mich., Marquette—S. J. Groves & Sons, 306 Globe Bldg., Minneapolis, Minn., awarded contract for r. c. 20-ft. rdway on F. A. P. 108-49, Marquette Co., at $162,709; 8.839 mi.

Miss., Corinth—McElrath & Rogers, Grenada, Miss., awarded contr. by State Hwy. Dept., for 10 miles Lee Hwy. bet. Corinth and Iuka, at $89,622.

Miss., Greenwood—E. A. Finch, Hattiesburg, awarded contract to repave certain streets and avenues, totalling 44,382 sq. yds., at $200,000.

Miss., Grenada—Independent Paving Co., American Trust Bldg., Birmingham, Ala., awarded contract for paving 35,300 sq. yds. with sheet asphalt on 5-in. concrete, curbing, guttering, etc., at $117,-000.

Miss., Grenada—J. R. Strouddy, Okolona, awarded contract for graveling 16 miles West Rd. bet. Grenada and Tallahatchie line, at $115,941.

Mo., Independence—Highway Construction Co., Webb City, Mo., awarded contract to pave 4 miles Kansas City-St. Louis road, Jackson Co. from Blue Ridge Rd. to end of conc. pavement on Raytown Rd., at $123,781.

Nev., Carson City—F. A. Dahle Constr. Co., Logan, Utah, awarded contract by State Hwy. Dept. for constr. of culvts. and placing gravel surf. bet. Caliente and Piocho, Lincoln Co., at $269,845.

N. J., Freehold—Jannarone Constr. Co., 225 Passaic Ave., Belleville, awarded contract for rein. conc. paving, 2 miles Red Bank-Oceanport Rd., at $102,430; conc. paving Riverside Dr. in Red Bank, to Tuller Constr. Co. Red Bank, at $115,970.

N. Y., Middletown—Schunnemunk Construction Co., Highland Mills, awarded contract by C. H. Smith, Supt. of Hwys., Orange County, Middletown, for bitum. macadam on 3 miles of rd. in twn. of Warwick; also concrete pavement on 3.75 miles rd in towns of Minisink and Greenville, at $280,126.

N. C., Beaufort—Simmons Construction Co., Charlotte, awarded contract for paving Front St. and several cross streets at $100,000.

N. C., Charlotte—Noll Construction Co., Charlotte, awarded contract for surfacing 8 miles Lawyers' Rd., 18 ft. asph. on concrete, at $240,000.

N. C., Troy—W. F. Bowe, Jr., Augusta, Ga., awarded contract for hard surfacing various streets, at $175,000.

Okla., Tulsa—City let contracts for paving streets in Dist. 492, as follows: portion of 17th St. and Olympia Ave., vibrolithic, to Western Construction Co., Boise, Idaho, at $75,464; Dist. 493, conc., to Standard Paving Co., at $10,091; Dist 494, vibrolithic, Western Constr. Co., Boise, at $44,391; Dist 295, asphalt to Standard Paving Co., at $22,434; Dist 496 to same firm, at $9,454; Dist. 497, also let to Standard Paving Co., at $130,370.

Pa., Harrisburg—D. S. McGrath, Inc., Adams, Mass., awarded contr. for F. A. P. 422, Pownall, at $105,564.

Pa., Harrisburg—State Hwy. Dept., let following contracts for road impvts: (A means Application and R means Route)—18,206 ft. A 2573-74 and 75, Delaware Co., to V. DiFrancesco, Llanerch, at $176,287; 2,203 ft. A 2578 Beaver Co., to D. W. Challis & Sons, 420 Centennial Ave., Sewickley, at $36,055; 3,666 ft. R 163, Lehigh Co. to S. N. Weaver, Allentown, at $64,967; 20,005 ft. R 175, Northampton Co. to Juniata Co., 410 Empire Bldg., Phila., at $111,190; 13,627 ft. R 165 and 166 Northampton Co. to McInerney & McNeal, Easton, at $134,918; 12,017 ft. R 111, Greene Co. to Myers Paving Co., Waynesburg, at $37,394.

R. I., Providence—State Board of Public Works let contract for paving 3.53 miles rd. in Westerly and Bradford, 18 ft. bitum, conc. to Bonfiglio, Perini & Sons, Ashland, Mass, at $57,596; 2.63 mi. in West Greenwich and Exeter, 18 ft. rein. conc. Contr. 2308, to J. Bristow, Narragansett Pier, at $109,133.

Tenn., Athens—Calloway & Co., Lenoir City, Tenn., awarded contract at $95,000 for additional street impvts.

Tenn., Nashville—R. A. Martin, Fountain City, awarded contract for 14.64 miles hwy. in Scott Co., at $137,593.

Tenn., Nashville—State Hwy. Dept. let following contracts for road impvts: Surfacing 7.99 mi. F. A. P. 94, Benton Co., to Little & Dean, Memphis, at $154,570; 11.02 miles F. A. P. 96, Bedford Co., bitum. mac. to Boyd Williams, Murfreesboro, at $22,258; 7.53 mi. State Proj. 115, Lewis Co. chert, to C & C Constr. Co., Hohenwald, at $57,161; 10.78 mi. St. Proj. 126, Summer Co., rock asphalt, to Rhode Carr Co., Nashville, at $162,074; 12.3 mi. St. Proj. 127, Summer Co.; gravel; to S. W. Brown Sons Co., Westmoreland, at $111,150.

Tenn., Newport—Murray Constr. Co., Holston National Bank Bldg., Knoxville, awarded contract for paving various streets; asphalt on concrete, at $130,000.

Tenn., Rockwood—West Construction Co., Chattanooga, warded contract at $124,981 to pave Rockwood Ave.—Kingston Ave. to Spring St.; Kingston Ave. 3 blks. so. and 5 blks. west from Rockwood Ave.—asph. concrete base. City also plans to install "White Way" on several blocks in business dist. Chas. Barnett supervising pavement construction.

Tex., Bonham—Julian C. Field & Co., Denison, Texas, awarded contract by Fannin County for 7.35 miles 18-ft. concrete rd. on State Hwy. No. 5, Fed. Aid Proj. 344, at $243,532.

Tex., Eastland—Chapin-Kemp Co., 810 Austin St., San Antonio, awarded contract for 18.69 miles bitum. macadam pavement on St. Hwy. No. 18—Eastland to Gorman—at $94,821; 10.04 miles bitum. macadam pavement on St. Hwy. No. 22—Eastland no to County line—at $61,883.

Tex., Edinburg—W. L. Pearson, San Antonio, Tex., awarded contr. to extend highway across Hidalgo Co. from Cameron Co. line to Starr Co. line; bitum. topping, at $700,000.

Tex., Houston—Gulf Bitulithic Co., 701 Foster Bldg., Houston, awarded contract to pave Polk Ave.—Hutchins to Dumble Sts.—at $152,941; 2-in. Warrenite-bithulithic on 6-in. conc. base.

Tex., Houston—Smith Bros., Inc., Houston, awarded contract to lay 28,800 sq. yds, asph. conc. on concrete base on Waugh Drive, at $100,087.

Tex., McKinney—D. H. Purvis & Son, McKinney, awarded contract at $140,000 for 4 roads embracing 23 miles radiating out of McKinney; gravel resurfacing, at $140,000.

Va., **Richmond**—State Hwy. Dept., Richmond, let contracts for 3 road projects as follows: 276-A Louisa and Albermarle Cos., 9 miles from pt. 2 mi. west of Trevillians, Louisa Co. to 1 mile west of Cobham, Albemarle Co. to Ellis-Brooke Co. Staunton, Va., at $324,397; S-238, Rte. 39, Elizabeth City Co. 1.8 mi. from Phoebus to Buckroe Beach, to Cannaway Hudgins Co., Hampton, Va., at $43,317.

Wash., Seattle—Fiorito Bros. awarded contract by King Co. Engr. Thos. R. Beeman for paving 2 miles Renton-Maple Valley hwy.—Renton up Cedar River valley, at $127,000. Specfs. call for 20-ft. conc. pavement 8 ins. thick in center and 6 ins. thick at edges.

W. Va., Fayetteville—J. E. Dougher & Sons, Charleston, awarded contract for vit. brick paving in Fayette Co., on 3 miles Lookout-Lansing Rd., Nuttall Dist., at $99,500.

SEWERAGE AND SEWAGE TREATMENT

Cal., Long Beach—Lloyd C. Campbell, 350 Merrick St., Los Angeles, awarded contract by Council for constr. of cement sewer system in San. Sewer Pump Dist. No. 1, embracing State, Chestnut, 19th and other streets and alleys, at $139,228.

Cal., Los Angeles—Smith Bros., Inc., and Callahan Constr. Co., Detwiler Bldg., awarded contract for Sec. 10, outfall sewer, 1,440 lin. ft. 6-ft. and 6,127 lin. ft. 8-ft. 6-in. pre-cast pipe, etc., at $214,443; J. Balch, 696 12th St., San Pedro, awarded contr. for furnishing city with submarine rein. conc. pipe in Sec. 1, no. outfall sewer, at $147,000; Merritt, Chapman & Scott Corp., 17 Battery Pl., New York City, contract for laying pipe, at $496,000; Geo. R. Curtis, 2440 E. 26th St., awarded contract for impvt. of Hobart Blvd.—Lemon Grove Ave. to Melrose Ave.—at $14,691; Nick Bebek, 425 W. 78th St., awarded contract for constr. of sewer in Florence Ave.—Normandie Ave. to 161 ft. w. from Denker Ave.—at $18,800; Leo Miletich, 610 W. 54th St., awarded contract for constr. of sewer in Verdugo Rd., at $7,500; Frank H. Brigham, 348 S. Hope St., awarded contract for constr. of storm sewer in Ventura Blvd.—Sunrise Pl. to Peace Pl.—at $5,366.

Cal., Pasadena—Leo Miletich, 610 W. 54th St., Los Angeles, awarded contract for constr. of 8-in. vit. pipe san. sewer in Arroyo Blvd., bet. Wash. and Montana Sts. Dakota St.—Forest Ave. to 1,305 ft. west and in Dakota St.—Forest Ave. to 734 ft. east, etc., etc., at $159,733. Total length: 86,000 lin. ft. Work involves 8, 12, 12, 16-in. vit. pipe; 300 manholes and 70 flushtanks.

Ont., Fort William—J. J. Flanigan, Cochrane, Ont., awarded contract to construct sewage disposal plant at $50,000.

Ont., Riverside—Coulatti Bros., Ouellette Ave., Windsor, Ont., awarded contract for sewers, at $75,000.

Que., St. Therese—Ovilla Filion & Frere, 2985 St. Denis St., Montreal, awarded contract for sewers at $110,000.

Fla., Deland—I. C. Mishler, Chattanooga, Tenn., awarded contr. to construct sewer system: will lay 6, 8, 10, 12, 18 and 24-in. clay pipe, at cost $150,000; install 2 Imhoff tanks, 22 ft. diam., 25 ft. deep, $5,000 each.

Fla., Miami—J. B. McCrary Engrg. Co., 3rd National Bank Bldg., Atlanta, Ga., awarded contract for 15 miles san. sewers and laterals, at $176,502.

Fla., Miami—J. J. Quinn Co., Miami, awarded contract for 3,960 ft. terra cotta and 5,685 ft. conc. storm sewers, at $110,000.

Ia., Sioux City—C. F. Lytle Constr. Co., 504 Nebraska St., Sioux City, awarded contract for conduit 14x39 ft. inside, at $314,055; broken stone construction, 50,000 c. y. earth excav.

Kans., Russell—Ammerman & Snyder, Wichita, awarded contract for san. sewers and disposal plant, at $72,736.

Ky., Ashland—J. H. Sluss Constr. Co., Graham, Va., awarded contract for sewerage system, at $270,626.

La., W. Monroe—McIntosh Co., New Orleans, awarded contract for 44,750 ft. 8-in., 1,194 ft. 10-in., 804 ft. 12-in., 1,943 ft. 15-in., 2,126 ft. 18-in., 3,711 ft. 22-in., 1.394 ft. 24-in. pipe in various streets, at $94,000

Md., Baltimore—Ryan Constr. Co., Real Estate Trust Bldg., Phila., Pa., awarded contract for constr. of Gwinn Falls intercepting sewer, Sec. 3, at $92,336.

Mich., Detroit—Following contracts let: Rennie & Dibble, 9144 Linwood Ave., at $8,960; Lat. 3982 to J. J. Reading, Detroit, at $22,577; Lat. 3990 to Hammon & Co., 4612 Woodward Ave., at $10,988; Lat. 3992 to S. Healey, Detroit, at $10,500; Lat. 3864, to S. Fattore, 2201 St. Joseph Ave., at $10,380; Laterals 3985, 3986 and 3989 to W. Blanck & Co., 827 Ford Bldg., at $9,450, $3,801 and $30,446, respectively.

Mo., Richmond Heights—(St. Louis, P. O.) R. D. Clark, Cape Girardeau, awarded contract for 17,500 ft. 6-30-in. vit. clay and 33-60-in. segmental block sewers; Engr's. est., $69,000.

N. J., East Orange—Spiniello Constr. Co., Newark, awarded contract for Elizabeth River Drain, 1 mile long, mostly in rein. conc. pipe, at approx. $95,000.

N. J., Ridgefield Park—Suburban Engrg. Co., 15 W. 38th St., New York City, awarded contract for sludge drying beds and East Side and West Side sewage treat. plants; Engineer's est. $50,000.

N. Y., Troy—H. W. Golden & Sons, 4 Elm Pl., awarded contract for laying 1,750 ft. 30-in. sewer in 10th St., 920 c. y. earth and 1,148 c. y. rock trenching, at $166,409.

Ohio, Cleveland—Langahan Constr. Co., Marshall Bldg. ,awarded contract for 16,000 ft. 8-in. and 16,000 ft. 12-60-in. tile sewers in Impvt. 3—of Co. Sewer Dist., at $219,000.

O., Euclid—Folowing contracts let: Sewers in Lake Shore Blvd., Sec. 1, to Amato Constr. Co., care Sewer Contractors' Exch., The Arcade, Cleveland, at $73,699; Lake Shore Blvd. sec. 2, to Graham & Henderson, 1274 W. 108th St., Cleveland, at $93,027; submerged outfall sewer in Lake Shore Blvd., to Cleveland Engrg. and Constr. Co., The Arcade, Cleveland, at $67,787.

O., Maple Heights—(Bedford, P. O.) B. J. Whittaker, 2269 Noble Rd., Cleveland, awarded contract for 8,617 ft. 15-20-in. vit. clay sewers in Dunham Rd., Sec. 1, at $58,862.

Pa., Philadelphia—M. & J. B. McHugh, 802 Markoe St., awarded contract for Northeast sewage treatment works, Wheatsheaf Lane, east of Richmond St., at $76,331.

Pa., Philadelphia—W. G. I. Contg. Co., Arch and Broad Sts., awarded contract for substruct. and superstruct. of Southwest sewage pumping plant, 40th Ward, at $174,132.

Tenn., Ripley—Sullivan, Long & Hagerty Constr. Co., Bessemer, Ala., awarded contract for complete sewerage system, at $74,800.

Tex., Grand Prairie—R. J. Estep & Co., Deere Bldg., Dallas, awarded contract for sewer mains, laterals and disp. plant, at $52,200.

Wash., Seattle—Fiorito Bros., awarded contract for sewers in 9th Ave., no. et al, at $32,053.

W. Va., Spencer—D. Fosco, So. Charleston, W. Va., awarded contr. to construct sewer system, at $37,545.

Wis., Rhinelander—W. D. Lovell, 1415 8th St., S. E., Minneapolis, Minn., awarded contract for sewerage system, 26,502 ft. vit. or concrete pipe, at $78,981.

WATER SUPPLY AND PURIFICATION

Ark., Ft. Smith—Benson & Farrer, 120 S. 2nd St., Guthrie, Okla., awarded contract by Water Works Dist., for furnishing lead and yd., trenching, laying and backfilling abt. 64,000 ft. cast iron pipe, at $39,239.

Cal., San Diego—Pittsburgh-Des Moines Steel Co., Curry Bldg., Pittsburgh, Pa., awarded contract for constructing 1,200,000 gal. steel standpipe for water distributing sys., at $69,150.

Cal., Watts—Neptune Meter Co., 701 E. 3rd St., awarded contr. for furnishing 2,000 meters to the Conservative Water Co., Watts, for use in connection with improvements being put in by that company under recent $250,000 bond issue. New pumping plants, including motors, will be installed.

Que., La Salle—L. O. Ott & Co., Ltd., 10 Cathcart St., Montreal, awarded contract for extension to water and sewage systems, at $95,000.

Que., St. Lambert—W. I. Bishop Constr. Co., Ltd., 10 Cathcart St., awarded contract for laying 1,960 ft. 30-in. concrete pipe from water works to point in St. Lawrence River, at $33,980.

Iowa, Dubuque—Jas. Gregory, 1129 Iowa St., awarded general contract for water works sta., 1 sty., brick, blt. up rfg., $50,000; pump sta., 1 sty. brk., $15,000.

Mich., Lincoln Pk.—(Wyandotte, P. O.)—T. C. Brooks & Son, Jackson, Mich., awarded contract for furnishing 37,000 lin. ft. 6 and 8-in. cast iron pipe with hydrants, etc., at $80,000.

Minn., Hibbing—Phelps-Drake Co., 219 Power Bldg., awarded contract by Bd. Education of Hibbing and twn. of Stuntz, for extending mains bet. here and Stuntz, to serve twns. of Stuntz, Morton, Leetonia and Kelly Lake, within 5 mile radius of Hibbing, at $150,000.

Mo., Jasper—E. K. Ladd Construction Co., awarded contract to construct water works system, at $31,927.

N. Y., Rochester—Rochester Willite Co., Rochester, awarded contr. by Monroe Co. and Manitou Beach Ry. Co., for constr. of water supply system from Rigney's Bluff to Manitou Beach, at $162,000.

N. C., High Point—Tucker & Laxton, Charlotte, awarded contract for constr. of 3 pumping stations to cost approx. $38,000; Morris Machine Works Charlotte, contr. for pumps and motors.

Ohio, Cleveland—J. Lewis, Sewer Contractors' Exch., awarded contract for 37,000 ft. 6-10-in. cast iron mains, Contr. 43, at $139,000.

Ohio, Fairview—Hadded & Kariel, 415 Eagle Ave., Cleveland, awarded contract for about 9 miles 6, 8, and 10-in. cast iron mains, at $65,000; Joseph Kalill & Jackson, Bangor Bldg., Cleveland, awarded contract at $94,000 and Hanna and Company, Leader Bldg., Cleveland, contract at $65,000; both these contracts being included in above mentioned impvts.

Okla., Maysville—Gibson & Mitchell, auls Valley, awarded contr. for water distribution system, including pump sta., tank, tower, 12,000 ft. 4-6-in. cast iron pipe, etc., at $33,833.

Okla., Tulsa—Contract let to De Laval Steam Turbine Co., No. Clinton St., for two 12-m.g.d. high serv. steam turbine driven centrif. pumps, at $84,-300; Walsh & Weidner Boiler Co., Main & Sycamore Sts., Chattanooga, Tenn., 2 300-h.p. water tube boilers with Green chain grate stokers, at $24,215. Above equipt. is for Mohawk pumping station, contract for which will be let about Oct. 1st.

Ore., Jennings Lodge—Parker-Schram Co., Couch Bldg., Portland, awarded contract for Oak Lodge Water Dist., 27,000 ft. lap weld 8-in. pipe, 11,000 ft. 8-in. and 20,000 ft. 6-in. c.i. pipe, 20,000 ft. 4-In. and 90,000 ft. 2-in. steel pipe, 600,000 gal. conc. reservoir, 40,000 gal. tank on conc. base, 150 g.p.m. elec. dricen pump, at $177,000.

Tex., Sabinal—Pittsburgh-Des Moines Steel Company, Praetorian Bldg., Dallas, awarded contract for 100,000-gal. steel tank and tower, at $40,000.

Va., Richmond—J. E. Nelson & Sons, 3240 S. Michigan Ave., Chicago, Ill., awarded contract by Chesapeake & Ohio R. R. Company, Richmond, for water treating plants at Foster and Maysville; est. cost of each, $40,000.

Wis., Cedarburg—City will lay 2,000 ft. 4-in. cast iron mains and 2,500 ft. 4-8-in. vit. sewer by Day Labor; est. cost $150,000. W. J. Kirchoffer, Dean Bldg., Madison, Engr.

Wis., Marshfield—Layne & Bowler, Memphis, Tenn., awarded contract for water mains, pumps, wells, etc., at $160,000; Pastoret Constr. Co., Duluth, has sublet work to Trierweiler Bros., Marshfield. Work includes 60 tons rein steel, 1 110 c.y. excav., 2,100 ft. box storm sewer 4x8 ft., $30,000.

Wis., Milwaukee—Link Belt Co., 910 S. Mich. Ave., Chicago, awarded contract by Central Bd. Purch for coal and ash-handling equipment for Riverside Pumping Sta., at $44,800.

Prospective Work

ROADS AND STREETS

Fla., Frostproof—City plans 11 miles street paving; asphalt. Contemplates voting on $300,000 bonds.

Fla., Milton—Santa Rosa County plans to construct 12 miles rd. from Yellow River brdg. to Oskaloosa Co. line. C. H. Overman, Co. Engr.

Ky., Paducah—McCracken County considering bldg. and repairing 3 roads as follows Cairo Rd. to Maxon; Lovelaceville rd.—Lone Oak toward County line; Paducah and Benton Rd. Contemplates voting Nov. 17th on $250,000 bonds. Jas. M. Lang, Co. Judge.

Minn., Crookston—Petitions presented to City Council for repaving with sheet asphalt Holly Ave., Houston Ave. and N. Ash St; also repaving S. Ash St. with Trinidad pitch Lake asphalt. B. M. Loken, City Clk.

Neb., Omaha—Following street impvt. work will be done this Fall: Dist. 2436 28th St. bet. Corby and Binney Sts., asphalt, stone vit. brk. vit. brk. block, artificial stone, macadam, creo. wood blk. or asph. concrete. Claude F. Bossie, City Clerk. Paving and curbing in Dist. 1475, 18th St.—Pratt to Laird St. Grading Dist. 116, Valley St.—32nd to 34th Sts. Dist 115, 51st St. bet. Miami St. to Corby Sts.; Corby St.—50th to 51st Sts.

N. J., Asburk Park—Two miles of Cookman Ave. and Kingsley Street may be resurfaced. Est. cost $167,000. N. Rogers, Asbury Park, Engr.

Okla., Tulsa—City plans paving streets in 13 districts. Total cost $18,000.

Ore., Portland—Impvt. of Baker-Unity hwy. over Dooley mountain, Baker Co., on 50-50 basis, arranged at session of State Hwy. Comn., after conference with delegation from Baker. Cost of rd. from Baker to top of hill est. at $241,000. Baker Co., has available $100,000. If plans for adjustment of balance of County's share are approved by County, State Comn., will advertise for bids.

Pa., Erie—City considering paving 29th and 36th Streets with brick at cost of abt. $47,600. F. C. Lynch, City Engr.

Pa., Harrisburg—Vote will be taken at November election on $50,000,000 bond issue for road impvts.

S. Dak., Elk Point—12.5 miles of F. A. P. 153, Union County, will be graveled. Est. cost $62,150. Raymond E. Lyle, Aud.

Tenn., Somerville—State Hwy. Dept., Nashville, Tenn., plans to construct 9 miles hwy. in Fayette County bet. Tipton Co. line and Shelby Co. line. Fed. Aid Project. J. G. Creveling, Commr.

Tex., Angleton—Secy. of Agriculture, U. S. Bureau of Pub. Rds., Wash., D. C., considering impvt. of F. A. P. No. 367, 17.24 miles 16-ft. shell rd. on Houston-Angleton Hwy. St. Hwy. No. 19 extending so. from Ft. Bend Co. line through Rd. Dist. No. 16 of Brazoria Co. Est. cost $260,000. Fed Aid $30,000. H. W. Hinson, Jr., Engr. Rd. Dist. No. 16 and J. L. Loggins, Co. Judge, Angleton, Tex.

Tex., Baird—Callahan County Road Dist. No. 1 plans to pave 3 miles Bankhead Hwy.—Eastland to Taylor County line. $200,000 bonds voted.

Tex., Franklin—Robertson County plans to construct 15 miles Meridian Hwy. in Rd. Dist 2—Hearne to Brazos County line. Est. cost $175,000. L. A. Peterman, Engr. Rd. Dist No. 2, Hearne; Joe Reid, Co. Judge, Robertson County.

Tex., Jasper—Jasper County will soon receive bids for gravel surfacing 7.9 miles State Hwy No. 7 west from Indian Creek. Est. cost $65,000. C. P. Hunter, Co. Engr. A. D. Hancock, Co. Judge.

Tex., Kountze—Hardin County contemplates bldg. 2 sections of roads: 4.43 mi. gravel rd. on St. Hwy. No. 8. Est. cost $49,000; 131 mi. gravel surf. rd. on St. Hwy. No. 8, including constr. timber pile trestle bridge. Est. cost $52,800. Geo. C. Brown, Co. Engr. T. E. Steele, Co. Judge.

Tex., La Grange—Fayette County contemplates bldg. 14 miles St. Hwy. No. 3-D bet. La Grange and Colorado Co. line. Est. cost $150,000. Capt. A. Schlafle, Engr., Co. and J. P. Ehlinger, Co. Judge, La Grange.

Tex., Leakey—Real County plans to build 17.8 miles Kerrville Rock Springs Hwy. Est. cost $70,-000. W. E. Simpson Co., Co. Engrs., National Bank of Commerce Bldg., San Antonio; J. L. Youngblood, Co. Judge, Leakey, Tex.

Tex., Marlin—Falls County plans bldg. 2 sections of rd. as follows: Gravel surf. 7.65 miles State Hwy. 44. Est. cost $92,000. Construct rein. conc. and treat. pile trestle draing. structs. and gravel surf. on 5.68 mi. State Hwy. No. 44. Est. cost $101,000. J. P. Wehrung, Co. Engr., Lott, Tex. Walter S. Hunnicutt, Co. Judge, Marlin.

Va., Richmond—Election November 6th to vote on $1,200,000 bond issue for new road construction. M. G. Shirley, State Hwy. Commr.

Wis., Marshfield—Plans being made for 14 blks. paving on N. and S. Central Ave.; also 4 blks. on Litchfield Rd. Bids will be asked on conc. wood blk. and vibrolithic. J. H. A. Brahtz, 400 Metropolitan Theatre Bldg., St. Paul.

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Chausse Oil Burner Co.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Chausse Oil Burner Co.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Chausse Oil Burner Co.
Littleford Brothers.

Auto Fire Apparatus.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling & Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Hill, Nicholas S., Jr.,
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

SEWERAGE AND SEWAGE TREATMENT

Ala., Mobile—$350,000 bonds voted for sewer and water extensions.

Ark., Ft. Smith—City will receive bids in about 60 days for extension to sewer system. W. H. Evans, Engr.

Ont., Birch Cliff—Scarboro Twp. having plans prepared for rein. conc. sewage disposal plant. Est. cost $400,000. James, Proctor & Redfern, 36 Toronto St., Tor., Cons. Engrs.

Cal., Burbank—Board of Trustees has instructed City Engr. G. F. Miller to establish grade and complete plans for sewer system to be built under bond issue (funds from sale of bonds being now available). No means of sewage disp. decided upon but work will proceed in laying mains and laterals.

Cal., Elsinore—Burns & McDonnell Engrg. Co., 404 Marsh-Strong Bldg., Los Angeles, completing prelim. plans for sewage disposal plant here.

Cal., Long Beach—Bids will soon be taken by City for sewers (sanitary) in Bway. bet. Golden and Alamitos Aves. Est. cost, $50,000.

Cal., Los Angeles—City Engr. Jno. Griffin has ordered division of Eagle Rock territory into 3 districts and a complete survey made for sewerage system.

Cal., Martinez—Mountain View San. District having plans prepared for 10 miles 6-inch vit. lateral sewers. Engr., R. L. Calfee, 221 S. 22nd St., Richmond.

Cal., Orange—$190,000 outfall sewer bond issue carried at recent election.

Cal., Placentia—Plans for joint san. dist., embracing Placentia, Richfield and Yorba Linda, are under consideration by Comm. appointed by P. H. Kricke, Placentia, at recent mass meeting. Dist. is being formed with object of connecting new joint outfall sewer being built by Santa Ana, Orange, etc. Clyde Bishop, Santa Ana, retained as Atty. for new district.

Alta., Edmonton—Plans being prepared for an addition to sewage disposal plant. Est. cost, $60,000.

Ont., London—Plans being made for storm and san. sewers; also pumping plant in So. London. $300,000. W. P. Neal, City Engr.

Que., Outremont—Bids will soon be received for constr. of sewers. $51,259. E. T. Sampson, City Clk.

Ia., Oelwein—Will take new bids about Feb. for extension to disposal plant. Engr. Edw. B. Tourtellot; C. D. Shippy, City Clk.

Ia., Cedar Rapids—Petition being circulated for sewer and water extensions on J St. & W. bet. 13th and 233rd Aves. L. J. Storey, City Clk.

Iowa, Dubuque—Resolution adopted for bldg. 33 miles sanitary sewer in Lincoln Dist. and lay 12-in., 8-in. and 6-in. sewers in various streets. Jno. Stuber, City Clk.

Kan., Atchison—Prelim. plans being made for 3 blocks Big White Clay Creek open sewer. Est. cost, $75,000 to $100,000.

Kan., Pittsburgh—Prelim. plans being made for 7,500 ft. storm sewer to drain into Cow Creek, D. D. No. 2 and 7. $50,000 to $75,000. L. D. Cornelius, City Engr.

Kan., Wichita—Prelim. plans made for about 30,000 ft. 12 to 54 inch storm sewer in Cleveland Ave. Dist. $200,000. P. L. Brockway, City Hall, Engr.

Mo., Chillicothe—City having plans prepared by City Engr., for constr. of sewers on Wilson, Raynard, West Bryan and Zulu Streets.

Minn., Tracy—Will receive new bids for sewage disposal plant in February, 1924. L. J. Fitch, City Aud.

Minn., Winona—Plans being made for sewer extensions. Engr. E. E. Chadwick, 360 Vine St., Winona. Engr. G. W. Hoffman, City Clk.

Mo., Carthage—City having prelim. estimates and surveys made by Burns & McDonnell, Cons. Engrs., Kansas City, Mo., for sewerage works. Approx. cost, $50,000.

Mo., St. Louis—Fogg & Boyle Real Estate Co. will soon receive bids for 3,500 ft. 12-36-in. vit. clay sewers in Mars Pl. subdivision. $20,000 to $25,000. Dodds Surveying Co., 717½ Chestnut St., Engrs.

Neb., Pawnee—City contemplating making sewer connections in all residence districts. Florey, City Clk.

O., Dayton—Surveys and plans being made for sewage disposal plant. Est. cost, $1,000,000. Metcalf & Eddy, 14 Beacon St., Boston, Mass., Cons. Engrs.

Okla., Tulsa—City will vote in October on $800,000 bonds for constr. of main sewers. H. F. Newblock, Mayor.

Ore., Dallas—City Council voted to adopt plans and specfs. of E. J. Himes, Engr., for sewer construction which it is estimated will cost between $50,000 and $55,000.

Tex., Beaumont—City will install system in So. Park and Cartwright sections.

Tex., Lubbock—Citizens will soon vote on issuance of $500,000 bonds for storm sewers and paving. A. Saunders, Engr., Lubbock.

Wis., Madison—Plans being made here for sewage disposal plant. Includes Imhoff tanks. E. E. Parker, City Engr., E. Buser, City Clk.

Wis., Reedsville—Town contemplates bldg. sewerage system and disposal plant. Est. cost, $25,000. C. Hagenon, City Clk. Engineer not selected.

WATER SUPPLY AND PURIFICATION

Ala., Birmingham—Birmingham Water Works Co. plans development and extensions to water sys. in City and outlying districts. Included in present plans are following impvts.: Constr. of 5,000,000-gal. reservoir to supply Ensley, Wylam, Pratt City and Fairfield districts; installation of 2,000,000-gal. centrif. pump at Rosedale high service station; construction of 8 concrete filters at Shades Mountain.

Ala., Talladega—City considering constr. of rein. conc. reservoir at Taylor's Mills; water to be brought 4½ miles to reservoir then to City by gravity; will also install 2 centrif. pumps. Est. cost, $263,000.

Ariz., Williams—Burns & McDonnell Engrg. Co., 404 Marsh-Strong Bldg., Los Angeles, preparing prelim. plans for water works impvts. to be made here. Detailed report completed.

Ark., Texarkana—Texarkana Water Co. making plans for 14,000 ft. 6-in. mains in Texas section of town; also approximately 8½ miles in Arkansas side. Plans private.

Cal., Avalon, Santa Catalina—Wm. Wrigley, Jr., has ordered completion of the 14-mile pipe line from Middle Ranch to Avalon. Pipe line will supply city with 21,000,000 gals. daily. Project complete is estimated to cost $1,000,000.

Cal., Delhi—Delhi Land Settlement Colony having plans prepared for 3 pumping plants. Pumps will probably be 12-in. diam., requiring 25 h.p. or more, motors. E. G. Fortier, Delhi, Engr.

Cal., Gilroy—$87,000 bonds voted for extensions and repairs to water works system

Cal., Long Beach—City Council has authorized City Mgr., C. H. Windham, to purchase cast iron pipe, fittings, check valves and surge chambers for Water Dept. Cost not to be over $20,000.

Cal., Ramona—Chamber of Commerce has taken up with officials of City of San Diego, matter of securing some of the water from development of Sutherland reservoir, as proposed. Chf. Engr. Lippincott, San Diego Water Co., has been invited to Ramona for a conference.

Que., Beauport—Town Council having plans drawn for water wks. system to cost $200,000.

Ont., Ford—Ontario Bd. of Health has approved plans of Essex Border Utilities Comm., for filtration plant which will have sufficient capy. to serve all the Border Municipalities. Bids for this work will be called in November.

Que., Montreal—City plans to lay 12,300 ft. 12, 16, 20, 24 and 30-in. cast iron high pressure force main from McTavish reservoir to pumping sta. at Papineau St.; also 3,673 ft. 8-in. c. i. mains in 7 other streets. $16,786. E. Gauthier, Asst. City Clk.

Ont., Walkerton—$25,000 bonds voted for rebldg. old water works reservoir and erecting new standpipe (200,000 gals.); also additional pumps. F. B. James, Walkerton, Engr.

Ont., Windsor—$150,000 bonds voted for extension of water wks., cast iron mains, hydrants, etc. M. E. Brian, City Engr.

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machin-
Good Roads Machinery Co., Inc.
ery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Incinerators.
William F. Morse.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
The Barrett Co.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Cummer & Son., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L., The
Warren Bros. Co.

Pipe Cutters.
W. W. Stickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

Colo., Pueblo—Ord. passed providing for bond issue of $250,000 for extending, improving, repairing and maintaining South Side water works dist. No. 2.

Conn., Hartford—Bd. Water Commrs. contemplate making water main extensions. Est. cost, $100,000. Cons. Engr., C. M. Caleb, 1026 Main St.

Fla., Jacksonville—City considering voting on $350,000 bonds for lights, streets, sewers, water mains, etc.

Fla., Tampa—City contemplates constructing water works. Est. cost, $1,273,000. N. S. Hill, 112 E. 19th St., New York City, Engr.

Fla., White Springs—City will install water works system; $30,000 bonds available.

Ill., Springfield—Commissioners in favor of additional motor-driven pump with daily capy. of 6,000,000 gals. for water department.

Iowa, Washington—$80,000 bonds voted here for municipal water plant. S. J. Kellogg, City Clk.

Kans., Wichita—Wichita Water Co., considering making 6-in. pipe extensions in 30 blocks. 18 fire hydrants. P. L. Brockway, City Bldg. Engr.

Kans., Winfield—Prelim. plans being made for laying 4½ miles of mains from end of present wells to Albright Gardens. Est. cost, $112,000. H. P. Haynes, Winfield, Engr.

Ky., Louisville—Louisville Water Co., 3rd Street, contemplates laying about 2 miles 48-in. main from reservoir to Eastern Parkway. $100,000. J. Chambers, Chf.

Ky., Owensboro—Election will be held in November to vote on $100,000 bond issue; will extend water works.

La., Bossier City—$125,000 bonds voted for water works and sewers.

Md., Hancock—City will install water filtration plant with capacity of 500,000 gals.

Mich., Ecorse—Plans being prepared for 48,020 ft. 4, 6 and 8-inch cast iron pipe in various streets. M. L. Brown & Son, 403 Capitol Theater Bldg., Detroit, Cons. Engrs.

Mich., Eloise—Plans being prepared by Hoad, Decker, Shoecraft & Drury, Ann Arbor, Cons. Engrs., for 7,200 ft. 4, 6 and 8-inch Cl. B cast iron pipe from water storage reservoir so. of Mich. Ave. around Eloise Inst. bldgs.

Mich., Eloise—W. L. Brown & Son, 403 Capitol Theater Bldg., Detroit, Cons. Engrs., preparing plans for Wayne Company for 48,020 ft. 4, 5, and 8-inch cast iron pipe in various streets here.

Mich., Iron Mountain—$390,000 bonds voted here for purpose of purchasing water works and constructing filtration plant. Will also extend and improve distribution system. W. W. Daizell, City Engr.

Mich., Ithaca—City contemplates installing deep well plunger pumps and fire pump unit. Est cost, $11,000. Burd & Giffels, Powers Theater Bldg., Grand Rapids, Mich., Engrs.

Mo., Breckenridge—City has authorized E. T. Archer & Co., Kansas City, Mo., to prepare plans and estimate of installation of water and sewer systems.

Mo., Canton—$20,000 bonds voted for extension of water wks. and $60,000 for complete san. system. For detailed information, address The Mayor.

Mo., St. James—$33,000 bonds voted for water works, pumping plant and distribution sys. Engineer not selected. $12,000 voted for sewers.

Mo., Norborne—City having prelim. plans made for pumping plant, reservoir, tower, etc.

Mont., Laurel—$55,000 bonds voted here for water works. T. A. Rigney, Clk.

Neb., Papillion—City will soon receive bids for constr. of waterworks this fall. G. H. Rohrbough, Engr., George F. Oliver, City Clk.

Nev., Las Vegas—Land and Water Co. here planning extensive improvements to city water system.

N. J., Lambertville—City Commissioners have requested Lambertville Water Co. to extend their waterline so as to provide householders on Cottage Hill with water.

N. J., Park Ridge—City plans to receive bids about January for construction of water system. Est. cost, $200,000. H. J. Harder, 129 Market St., Paterson, Engr.

N. Y., Jamestown—Board of Public Utilities has requested estimate of necessary impvts., extensions and enlargements of water plant.

N. C., Gastonia—City (B. H. Parker, Mayor) will issue $200,000 bonds for comb. water and light plant; also $50,000 bonds for enlarging sewer system.

N. C., Marshville—City contemplates voting on $35,000 bonds for extension to water and sewer system.

N. C., Salisbury—City will issue $340,000 bonds for new sts., $35,000 for water works and $30,000 for sewers.

O., Geneva—It has been recommended that liquid chlorine disinfecting plant be installed here.

O., Parma Heights—(Cleveland, P. O.)—City plans to lay cast iron mains here at cost of $32,000. V. D. Croft, Old Courthouse, Engr., Cleveland.

O., Salem—Water works plant and main extensions planned. Est. cost, $300,000.

Okla., Enid—John D. Bomford, Cons. Engr., Masonic Temple, retained by City to prepare prelim. plans for proposed water extension.

Okla., Holdenville—$80,000 bonds voted by City for extension and improvement of water works system; also purchase of additional fire equipment.

Ore., Yoncalla—$35,000 bonds voted for municipal water works. Engineer not yet selected.

Pa., Monongahela—City Water Company will soon start extensive improvements, including 6 concrete filters of modern construction, repairs and enlargements in mechanical department of plant.

Penn., Shamokin—Sunbury Water Company is planning to enlarge intake in Susquehanna through which water is pumped into city mains.

Penn., Smethport—Borough considering purchasing privately owned water works and making addns., extensions and impvts.

Texas, Ennis—$50,000 bonds voted by City to build dam across Waxahachie Creek for new water supply.

Tex., Frisco—$40,000 bonds voted here for water works impvts.

Tex., Greenville—City plans to expend approx. $20,000 in constr. of water main to supply outlying districts.

Tex., Highland Park—(P. O., Dallas)—North Highland Impvt. League having plans prepared by Myers & Noyes, Engrs., Dallas, for necessary mains and fire plugs for water system.

Tex., Kenedy—City will spend $30,000 for impvts. to water wks. system; also erection of 100,000-gal. capy. tank and reservoir. Jno. W. Thames, Mayor.

Tex., Mart—Construction of reservoir, pumping station and laying 4 miles 10-in. and 2½ miles 8-in. cast iron pipe proposed. Est. cost, $200,000. Koch & Fowler, Central Bank Bldg., Dallas, Engrs.

Tex., Strawn—City will vote on $150,000 bond issue for water works system.

Va., Richmond—City contemplates voting on $1,500,000 bonds for water and gas extensions.

Va., Bluff City—City contemplates installing water works system. Will probably vote on $20,000 bonds. For detailed information, address Mayor.

W. Va., Keyser—City will install filtration plant in connection with water works system; $175,000 available.

W. Va., Parkersburg—City will soon vote on issuance of $249,990 bonds for mechanical filtration plant, 6 filters, 1 m. g. capy. each. J. M. Rice, Jones Law Bldg., Pittsburgh, Pa., Engr.

Wash., Aberdeen—City considering construction of $2,000,000 power plant on Wynooche river. At meeting of Council report of hydro-electric engineers, who have been investigating possibility of bldg. the plant, was read by City Atty. A. E. Cross. Plant capable of generating 27,000 h.p., could be built on the Wynooche and power furnished in Aberdeen and other harbor cities at not more than $75 per horsepower.

Wash., Centralia—City Commission considering constr. of second pipe line from Mitchell Creek to City's gravity water sys. Est. cost, $207,000. If financial condition of local sys. will not permit this construction, reservoir may be built; 5,000,000 gals. capy.

BUYERS' GUIDE

Pumps.
De Laval Steam Turbine Co.
Evinrude Motor Co.
Harris Air Pump Company.
Keystone Driller Co.
Smith Co., T. L., The

Reinforcing Fer Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Kentucky Rock Asphalt Co.
The Texas Co.

Road Binder.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Keystone Driller Co.
Littleford Brothers.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Buffalo-Springfield Roller Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co.
The Good Roads Machinery Co., Inc.

Roofing Material.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling & Harnischfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Pipe Joint Compound
The Barrett Co.

Sewer Rods.
Stewart, W. H.

Slide Rules.
Kolesch & Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.
Phoenix Mfg. Co.

Special Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Spreaders.
Austin-Western Road Machinery Co., The
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co., The
Littleford Bros.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co., The

Street Paving Material.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Road Machinery Co., The

Surface Heaters
Chausse Oil Burner Co.

Subgrading Machines
Austin Machinery Corp.
The Hug Co.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Tamping Machines.
Pawling & Harnischfeger.

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Trench Machinery.
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De Laval Steam Turbine Co.

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The Hug Co.

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The Texas Co.
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Direct Oxidation Process Corp.
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The Refinite Co.

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my car is better off and my own disposition is better. Simply proves that good pavement does pay dividends."

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Highway Construction Equipment Service

If in the market for any of the following highway construction equipment, so indicate by check marks, mail this page to ***Municipal and County Engineering,*** 702 Wulsin Building, Indianapolis, and price quotations and descriptive literature will be forwarded to you.

—Air Compressors
—Asphalt Plant, Portable
—Asphalt Plant, Railroad
—Asphalt Tools
—Asphalt Tool Wagon
—Bar Cutters and Benders
—Bars, Reinforcing
—Bins, Portable Stone
—Bodies, Dump Truck
—Brick Rattlers
—Catch Basin Covers
—Cement Testing Machinery
—Clam Shell Buckets
—Contraction Joint
—Cranes, Locomotive
—Crushers, Stone
—Drag Scrapers
—Dragline Cableway Excavator
—Dump Cars
—Dump Wagons
—Excavator, Crane
—Elevating Graders
—Gasoline Locomotives
—Gravel Screener
—Heaters, Asphalt
—Heaters, Tar
—Hoisting Engines
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—Industrial Track
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—Mixers, Hot
—Mixers, Paving
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—Motor Trucks (over 3 tons)
—Oil Distributors
—Portable Conveyor
—Portable Drilling Rigs
—Pile Drivers
—Pumps
—Reinforcing Steel
—Road Drags
—Road Forms
—Road Graders
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—Road Planes
—Road Plows
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—Road Scrapers
—Sand Dryers
—Saw Rigs
—Scarifiers
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—Skimmer, Scoop
—Steam Shovels
—Stone Elevators
—Stone Screens
—Stone Spreaders
—Surface Heaters
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—Tractors
—Trailers
—Turntables
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—Wagon Loader
—Wheeled Scrapers
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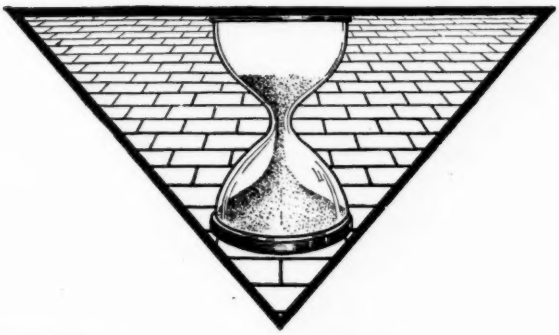

As Time Goes On

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Barr Clay Company
Streator, Ill.
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THE older a pavement grows, the heavier becomes its traffic burden. Therefore, we "pave for the future."

Some pavements deteriorate as they grow old. Heat, cold, and moisture bring about decomposition, disintegration and fatigue. The older they get, the weaker they get, and the heavier grows the traffic.

Vitrified paving brick, however, can not lose their "life." They are impervious. Temperature changes do not effect them. They are the same a generation hence as they are today.

That is why brick pavements are specified when genuine public economy—long life, low maintenance — governs the decision.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION
Engineers Building Cleveland, Ohio

VITRIFIED
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PAVEMENTS
OUTLAST THE BONDS

Water Works Equipment Service

If in the market for any of the following water works equipment, so indicate by check marks, mail this page to ***Municipal and County Engineering,*** 702 Wulsin Building, Indianapolis, and price quotations and descriptive literature will be forwarded to you.

—Air Compressors
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—Backfillers
—Brass Goods
—Chimneys
—Chloride of Lime
—Chlorinators
—Coal Handling Machinery
—Concrete Hoisting Equipment
—Concrete Tanks
—Condensers
—Conduit Rods
—Cranes, Locomotive
—Cranes, Traveling
—Curb Boxes
—Curb Cocks
—Derricks, Pipe Laying
—Derricks, Steel Portable
—Drinking Fountains
—Dry Feed Chemical Apparatus
—Engines, High Duty
—Engines, Gas
—Engines, Oil
—Engines, Pumping
—Explosives
—Fence, Iron
—Fittings, Wrought
—Filter Equipment
—Gates, Sluice
—Gauges, Recording
—Gauges, Steam
—Gauges, Water
—Goose Necks
—Hydrants, Fire
—Indicator Posts
—Lead
—Leadite
—Lead Furnaces
—Lead Wool
—Leak Indicators
—Liquid Chlorine
—Lime
—Meter Boxes
—Meter Couplings
—Meter Testers
—Motor Trucks
—Motors, Electric
—Oil, Lubricating
—Pipe, Cast Iron
—Pipe Cutters
—Pipe, Lead-Lined
—Pipe, Steel
—Pipe, Wrought Iron
—Pipe, Wooden
—Pitometers
—Pumps, Air Lift
—Pumps, Boiler Feed
—Pumps, Centrifugal
—Pumps, Deep Well
—Pumps, Steam
—Pumps, Trench
—Pumps, Turbine
—Pumping Engines
—Service Boxes
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—Standpipes
—Steam Boilers
—Steel, Reinforcing
—Sulphate of Alumina
—Tamping Machines
—Tanks, Elevated
—Tapping Machines
—Trench Braces
—Trenching Machines
—Valve Boxes
—Valve Inserters
—Valves, Gates
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Hauling 100 tons daily over the Sudan Desert

S. Pearson & Son, Ltd., of London, one of the largest contracting firms in the world, are building an enormous dam across the river Nile to provide a base water supply in the Sudan, and are also building 650 miles of irrigation canals. In beginning this great project, the Engineering Department of S. Pearson & Son, Ltd., was confronted with the almost insurmountable task of transporting machinery, fuel and supplies under extreme difficulties of soil and climate, and in a country where roads do not exist.

Various types of automotive equipment and tractive machinery were tried out under expert supervision but all proved inadequate. *For a scheduled daily transportation of 100 tons over an average haul of eight miles, no solution of the problem was possible except by the use of "Caterpillar"* Tractors. Consequently, a fleet of 10-Tons was purchased for this important project.*

The unequaled performance of "Caterpillar" Tractors in hauling great cargoes in the military service of the Allied Governments throughout the War, is reflected by the selection of "Caterpillars" by one of England's foremost contracting firms, to accomplish work too difficult and too important to entrust to any other method or machine.

In every tongue, "Caterpillar" is a synonym for power, traction and economy. We invite correspondence from engineers, contractors, public officials and industrial firms in regard to any problems of overland hauling, dirt moving, snow removal or construction work.

**There is but one "Caterpillar"—Holt builds it.*

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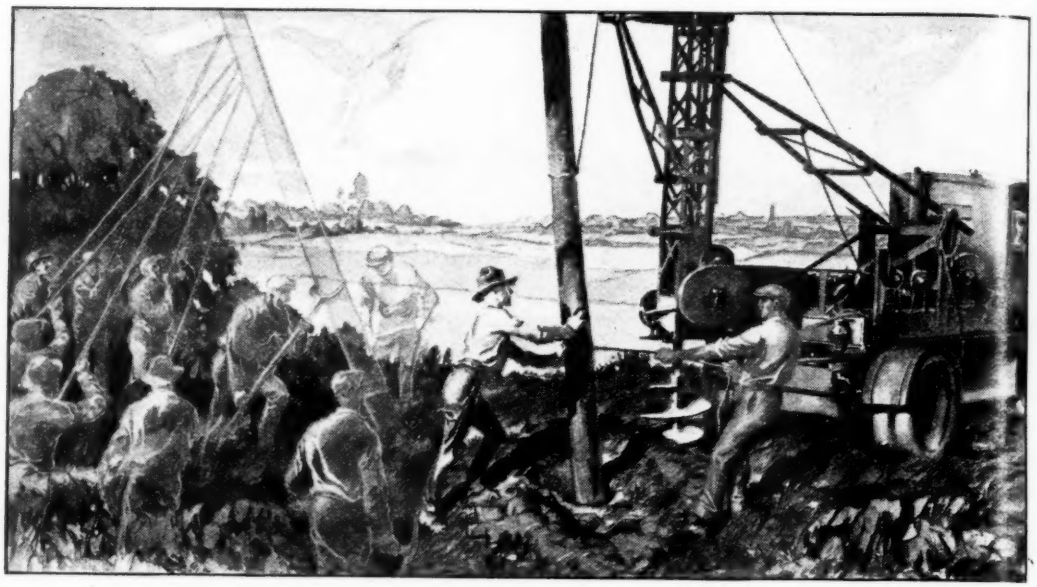


Multiplying Man-power

To the man with pick and shovel the digging of holes for telephone poles is a slow and arduous task. Under favorable soil conditions three to five holes are for him an average day's work. Under adverse conditions perhaps he can account for only one. When the hole is dug, eight or ten men are required to raise the pole with pikes.

But the hole-borer with derrick attached, operated by only three men, can erect as many as eighty poles in a day—releasing for other telephone work upwards of forty men.

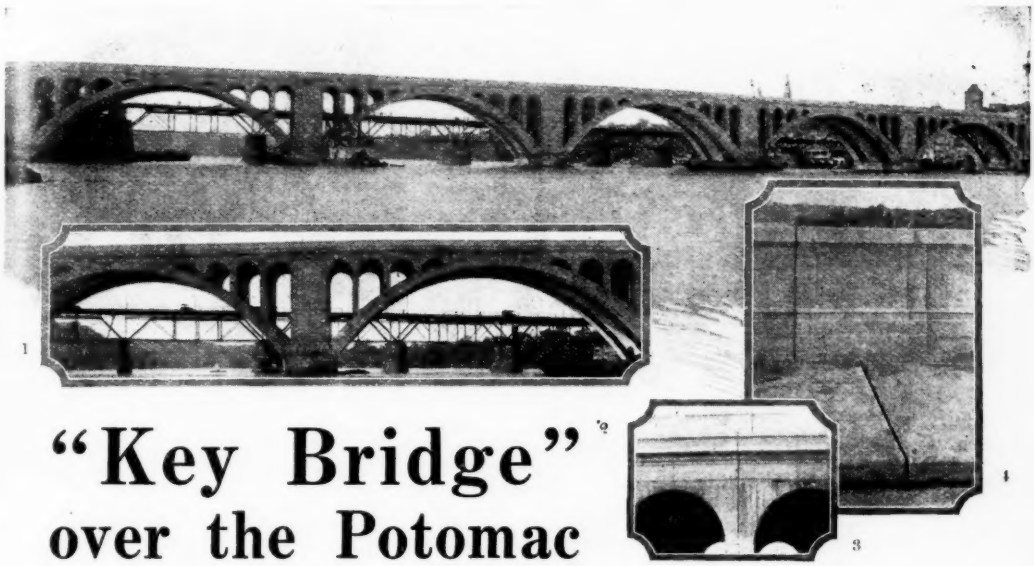
Hundreds of devices to quicken telephone construction, to increase its safety to the employee, and to effect economies are being utilized in the Bell System. Experiments are constantly being made to find the better and the shorter way to do a given job. Each tool invented for the industry must be developed to perfection.

In the aggregate these devices to multiply man-power mean an enormous yearly saving of time, labor and money throughout the whole Bell System. Without them telephone service would be rendered neither as promptly, as efficiently nor as economically as it is to-day.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service, and all directed toward Better Service



"Key Bridge" over the Potomac

"KEY BRIDGE," named after Francis Scott Key, composer of the "Star Spangled Banner," has been recently completed by the U. S. Army Engineer Corps.

The length of this splend'd concrete bridge is 2700 feet. It is 70 feet wide and 85 feet above mean low water. It accommodates two 16-foot roadways, two 8-foot sidewalks and a double-track electric railway.

Elastite Expansion Joint is used in the spandrel piers and walls, hand-rails, and sidewalks, be'ng particularly desirable in this type of construction because of its easy handling and installation.

Big stocks of Elastite Expansion Joint are carried in seventeen distributing centers, this means that all orders are shipped from a nearby point. Send for technical facts and sample.

1 — View of "Key Bridge," Washington, D. C.

2 — Close-up of center arches.

3 — Elastite Expansion Joint in spandrel pier.

4 — Elastite Expansion Joint in sidewalk and hand-rail.

THE PHILIP CAREY COMPANY
40 Wayne Ave., Lockland, Cincinnati, Ohio

Carey Elastite
TRADE MARK REG. U.S. Pat. Office
EXPANSION JOINT
PROVED AND ACCEPTED

Carey Elastite Expansion Joint is an asphaltic body, formed of a high-grade asphaltic compound carefully refined and tempered, sandwiched between two walls of asphalt-saturated felt forming an elastic, compressible joint. It is made in lengths, widths and thicknesses as required, can be cut to crown or to any special shape and comes to the job ready to use.

11-23

Why You Should in Your 1924

MOST engineers and officials in charge of the construction of streets and highways recognize the desirability of high type asphalt pavements. Half a century of hard usage in American cities has proven the value of asphalt surfaces from every standpoint. Only the cost and physical difficulties of laying the common hot mix types of asphalt on isolated highway projects or in the smaller cities, have prevented the more general use of asphalt pavements.

Kentucky Rock Asphalt has eliminated the difficulties and hazards of asphalt construction and made it practicable to lay asphalt surface of the highest type even on the most isolated project. Kentucky Rock Asphalt is a pulverized bituminous sandstone, a natural sheet asphalt mix which is shipped ready to lay *cold* on any standard base. Thus, heating and mixing equipment and expert asphalt workmen are eliminated. The finished pavement is a smooth sheet surface, superior in many respects to the ordinary hot types.

* * *

Kyrock is shipped in open-top coal cars. It does not set or pack in transit or in storage, and may be handled either with shovels or with machinery. The material is not susceptible to any damage from the elements and may be stored in the open, even for a period of years, without injury.

The rock asphalt is spread on the base, raked to the proper grade and rolled. The surface is then smooth and even and should immediately be opened to traffic.

Ease of maintenance is another outstanding feature of Kyrock pavements. Road

Include Kyrock Specifications

surfaces are constantly being disturbed for foundation repairs or for replacements of gas lines, water lines, etc. Cities without asphalt plants have been forced to unsatisfactory makeshift methods of repairing asphalt streets. Repairs to Kyrock pavements are simple. A few tons of the material may be kept in storage. When necessary to cut the rock asphalt surface, fresh material may be shoveled into the hole and tamped. After a few weeks' traffic the asphalt bonds so well that the patch may not be distinguished from the surrounding pavement.

* * *

Kentucky Rock Asphalt does not lose its life because it is not heated or mixed with any other materials. Sections under traffic for thirty-six years have been analyzed and show practically the same bitumen content as material shipped today. Because it is always live, Kyrock does not roll or crack. Cut the pavement today and, under normal traffic, it will rapidly heal. Kyrock pavements are as hard in Summer as the ordinary hot mix in Winter. Kyrock hardens under traffic, not by cooling, and is not affected by extremes in climate. The material is used with uniform success in Chicago and Miami, Fla., and in intervening cities.

Kentucky Rock Asphalt does not crack, roll, buckle or bleed. Because of the sharp angular character of its pure silica aggregate, it offers a non-skid surface.

* * *

Kentucky Rock Asphalt will help solve your street and highway problems, whether they be new construction or reconstruction. Kyrock is in successful use today on concrete, lime stone (macadam and modified Telford) and slag bases. It has proven highly satisfactory and economical in reconstruction of old brick, concrete, macadam and gravel roadways.

The famous Camp Knox road at Louisville, Ky., is a reconstruction with rock asphalt surface. This road carried all the army camp traffic and is in excellent condition today with practically no maintenance on the surface. Another notable example of rock asphalt surfacing over old macadam is the Canal-Winchester Road at Columbus, Ohio. The city of Indianapolis recently re-constructed one of the heaviest traffic sections of its boulevard system with Kyrock, surfacing over old gravel.

Our engineering department has prepared typical specifications for new construction and reconstruction using all standard types of bases. If these do not meet your local conditions, we shall be glad of an opportunity to consult with you in the solution of your problems.

* * *

Kyrock will give you the highest type sheet asphalt pavements at a reasonable cost. It makes possible satisfactory and inexpensive maintenance. It opens competition on asphalt pavements to responsible contractors equipped with ordinary road building machinery. It makes possible the salvaging of old, gravel, stone, brick, concrete and asphalt pavements which, otherwise, might have to be destroyed and completely replaced.

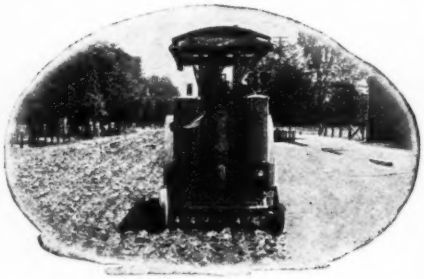
* * *

This word "Kyrock" insures uniformity in rock asphalt. It assures both engineer and contractor the co-operation of this company in planning and construction, to the end that the pavement may be successful. Consult our engineering department or write for literature. Ask for Booklet E-5.

Kentucky Rock Asphalt Company

(INCORPORATED)

711-717 Marion E. Taylor Bldg. **LOUISVILLE, KY.**

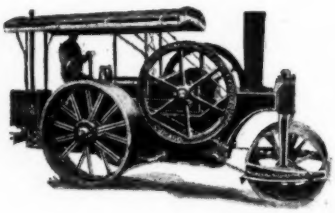


Nothing to Watch but the Road

That's why an **Austin Motor Roller** will do more and better work than any other. Because of its simplicity of control, the operator can watch his work all the time, and he wastes no time shoveling coal or taking on water.

An **Austin Motor Roller** will save you time and money in many ways. Better get acquainted before your next job.

The whole story is told in catalog F O. It's yours for the asking, and you will find it worth reading.



The Austin-Western Road Machinery Co.

Home Office: CHICAGO.

Branches in Principal Cities.

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ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA

"Everything from a Drag Scraper to a Road Roller"

AMERICAN STEEL & WIRE COMPANY

American Triangle Mesh and Electric Weld Reinforcing Fabrics

Wire Fabric Reinforcement for Concrete Roads Ensures Permanence

There is no form of road that is as economical, enduring and efficient as a concrete road. And when it is reinforced with steel wire fabric it is practically good for all time if the foundation and mixture are right.

Send for our new Road Building Book

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PIONEER Highest Quality ASPHALTS

PIONEER Highest Quality ASPHALTS

Filler Asphalt

The ideal brick pavement filler. Made to meet the strictest specifications. Low prices and immediate delivery on any quantity.

"PIONEER"

Every monolithic pavement should have an Expansion Joint. **"Pioneer"** is made from an absolutely pure asphalt, giving maximum expansion and contraction efficiency.

Expansion Joint

THE PIONEER ASPHALT CO.
LAWRENCEVILLE, ILL.

1/3 more per dollar

DUMORITE has cut blasting costs in many kinds of work. Its economy has been proven the country over.

Dumorite has approximately the same strength, stick for stick, as 40% dynamite, running 135 to 140 sticks to the case; as against 100 for "40%." The case price is the same.

Write our nearest branch office outlining your requirements, and you will receive full information on Dumorite as applied to your particular explosive problems.

E. I. DU PONT DE NEMOURS & CO., Inc.
Explosives Department
Wilmington, Delaware

Branch Offices: Birmingham, Ala.; Boston, Mass.; Buffalo, N. Y.; Chicago, Ill.; Denver, Colo.; Duluth, Minn.; El Paso, Texas; Huntington, W. Va.; Kansas City, Mo., Mexico City, Mexico; New York, N. Y.; Pittsburgh, Pa.; Portland, Oregon; St. Louis, Mo.; San Francisco, Cal.; Scranton, Pa.; Seattle, Wash.; Spokane: Wash.; Springfield, Ill.

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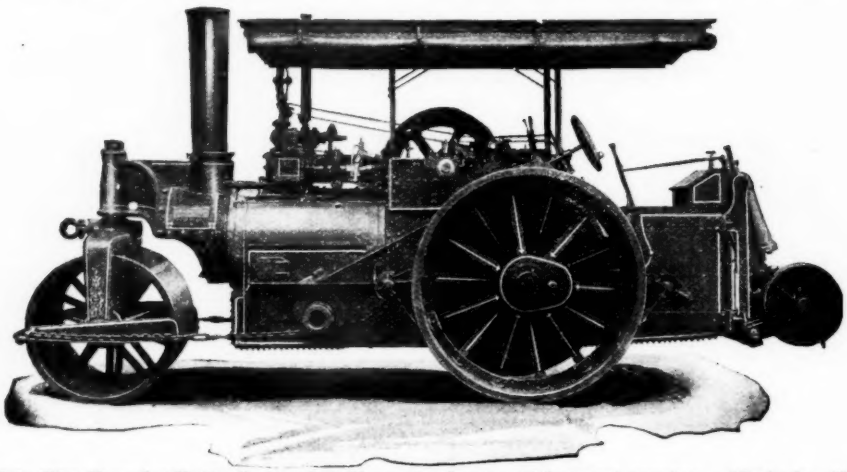
NON-HEADACHE DU PONT NON-FREEZING

DUMORITE

THE LATEST OF A COMPLETE LINE OF DU PONT EXPLOSIVES

Nitroglycerin, ammonia, gelatin and other types of explosives designed to meet every blasting requirement at least expense.

QUALITY ROLLERS



"Buffalo-Pitts" and **"Kelly-Springfield"** render best and longest service. Made in all types and sizes—steam and motor. Buffalo-Springfield Pressure Scarifiers are money-savers and can be furnished with new rollers or attached in the field to rollers already in use.

INQUIRIES INVITED

THE BUFFALO-SPRINGFIELD ROLLER COMPANY
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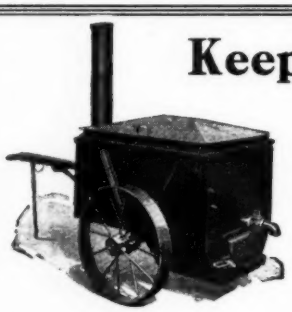

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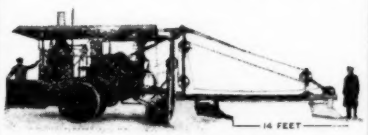

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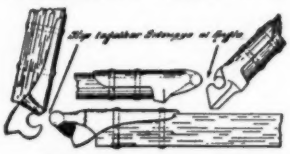

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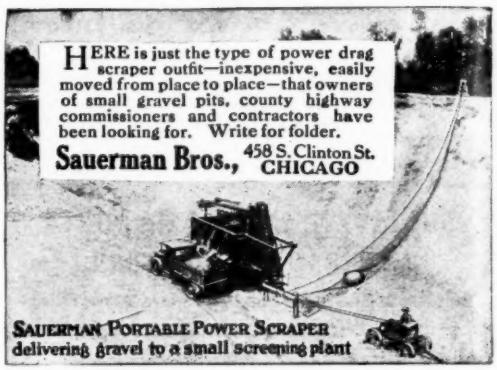
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EDITORIAL

A BALANCED NATIONAL SYSTEM OF TRANSPORTATION

For some time past the Chamber of Commerce of the United States has been showing keen interest in a proper co-ordination of highway, railway and waterway transportation facilities. A natural result of this study is a plan for linking organized motor transport with railroads in the development of a balanced national system of transportation. The plan is outlined in the report of the committee on the relation of highways and motor transport to other transportation agencies recently submitted to the president of the Chamber.

Important changes in prevailing methods of handling and distributing freight are proposed. Store-door collection and delivery to relieve congestion within crowded terminal areas of large cities; the use of organized and responsible motor transport to relieve railroads of various forms of uneconomical service, including the unprofitable short haul; the wider use of self-propelled railway cars, and the extension of passenger bus service to supplement existing facilities are recommended.

In connection with these changes the committee suggests the regulation of common carrier operations of motor vehicles by federal and state commissions which have supervision of rail and water carriers, and systematic development of highways in response to general traffic needs.

Those who have studied these questions, particularly the state regulation of motor transport, will be interested to know that the chairman of the committee is Mr. Alfred H. Swayne, vice-president of the General Motors Corporation. This committee is one of five appointed by the national chamber to study different phases of the transportation problem and to lay the groundwork for a national policy to be discussed at a general transportation conference to be announced later. It is said that the recommendations represent the unanimous view of all the important interests directly concerned in or affected by transportation. Its personnel includes railway traffic officials, officers of farm and labor organizations, representatives of the motor industry and motor haulage companies, water carriers and the shipping public.

The more important conclusions of the committee may be here briefly summarized as follows: Co-operation between the various agencies of transportation is preferable to wasteful competition. The greatest opportunity for co-operation is in the terminal areas of large cities. Store-door delivery by motor truck to relieve terminal congestion is the most promising method of solving the terminal problem. Organized motor transport can also relieve the railroads of various forms of uneconomical service, such as trapcar service, switching between local stations and short-haul shipments within the terminal area. More use should be made of demountable bodies, trailers and semi-trailers, containers and container cars, and mechanical handling appliances. Outside terminal areas there are distance zones, of varying extent, in which the motor is preferable for short hauls and the railway, or waterway, for long hauls. In intermediate zones competition is inevitable. Motor trucks and buses should be used to supplement the facilities of existing common carriers. The railroads should be permitted to discontinue unprofitable service to which the motor is better suited, and the motor should abandon its efforts to handle general traffic over excessive distances. Sound financal organization of motor transport is necessary, as well as public regulation of common carrier motor service. Passenger bus transport should be so regulated as to secure the best service to the public, certificates of public conveniences and necessity as already required in many states being a useful means of insuring reliable and continuous service. Rail lines can often advantageously extend or supplement their services by bus lines, and in states where this is now prohibited such restrictions should be abolished. Regulation of traffic and of size, weight and speed of motor vehicles by states and municipalities having control should be made more uniform within states and as between states. Regulation of common carrier operations of motor vehicles, including rate regula-

tion, should be handled by the federal or state authorities, under the comissions which now control the operations of rail and water carriers. Trunk highways in any area should be able to carry the normal vehicular traffic of that area, and, if the traffic economically justifies the use of especially heavy trucks, highways with stronger sub-bases must be provided. In general, present types of highways, present routes connecting principal centers of population and production, and the present trend in size, weight and speed restrictions of vehicles using highways show a rational system of highway development that should be continued. Investigations under way to determine the economic role of the motor vehicle should be continued.

The program of transportation co-ordination of the Chamber of Commerce of the United States, as above reviewed, is highly commendable in its purpose and scope, and generally well considered in its recommendations, but the editor of this magazine wishes to call attention to one phase of this question deserving close study and the eternal vigilance which is said to be the price of safety, in this case the price of safety for the development of highways and highway transport. Anyone who supposes that the railway managers of this country are ready to embrace motor transport is still somewhat ahead of the progress of events. Some are, of course; in fact some rail lines are utilizing motor transport, but others are fighting it.

The one positively dangerous proposal made by the committee of the Chamber of Commerce is that state public service commissions be given the absolute power of life or death over motor transport enterprises. Our words are not the words of the report but they mean the same thing for when a state regulatory body has the right to grant or withhold certificates of public convenience and necessity and to fix rates, schedules, etc., it has absolute power. Those who are ready to assume that such regulation will always be fair to motor transport are at liberty to do so. For our part the proposal fills us with forebodings and misgivings. In the first place motor transport is still in such a highly experimental stage of development that no one knows just how to regulate it, even with the purest of motives. It needs more time to develop by trial and error before fair regulation may be attempted with promise of success. Again, there has been much complaint about state regulation with only two parties involved; the public and one utlity. Think of adding a third party to this mix-up! The prospect gives us pause. What show will a small motor transport operator have when he must go before a commission and face the destructive criticism of the brilliant lawyers the rail lines are able to employ?

Not long ago the Illinois Commerce Commission denied a certificate of public convenience and necessity to a truck company operating a fleet of 40 trucks on regular published schedules in competition with three steam roads and an interurban line between Chicago and Joliet. The Commission ordered the trucking company, as well as several other companies uncovered in its investigation, to discontinue business. The Kipps Express and Van Company, which had petitioned for the certificate, was shown by the evidence to advertise and operate a regular daily service to 40 towns with published rates on connecting services between Chicago and five other towns from 20 to 50 miles distant. Regular warehouses and rate zones were also maintained. Some of these services were shown to have extended over a period of three years. The Commission stated that its policy is not to issue such certificates unless it can be shown that there is not adequate service and that the proposed carrier has the capacity to handle all the traffic, if need be.

The discerning reader will have no difficulty in perceiving the difference between the idealistic state visualized by the committee of the Chamber of Commerce of the United States and the state of affairs actually existing. The Chicago-Joliet district as an "outer-belt" district; just such a district as the committee must have had in mind when it spoke of "intermediate zones in which competition is inevitable." "Inevitable" under the free play of economic forces, but not under the ruling of the Illinois Commerce Commission. This Kipps case is most instructive and we hope will be impressive to all those who are ready and willing to tie up the future of motor transport and hand it over to the care and keeping of state public service commissions. In many ways we greatly admire the railways. Their achievements in many fields of endeavor are unequaled. For example, they have produced the greatest outdoor sign ingenuity has ever devised. It reads: "Stop, look and listen." We commend the message of this sign to those who favor state regulation of motor transport at this time.

MISSOURI'S ROAD PROBLEM

By B. H. Piepmeier, Chief Engineer, Missouri State Highway Commission, Jefferson City, Mo.

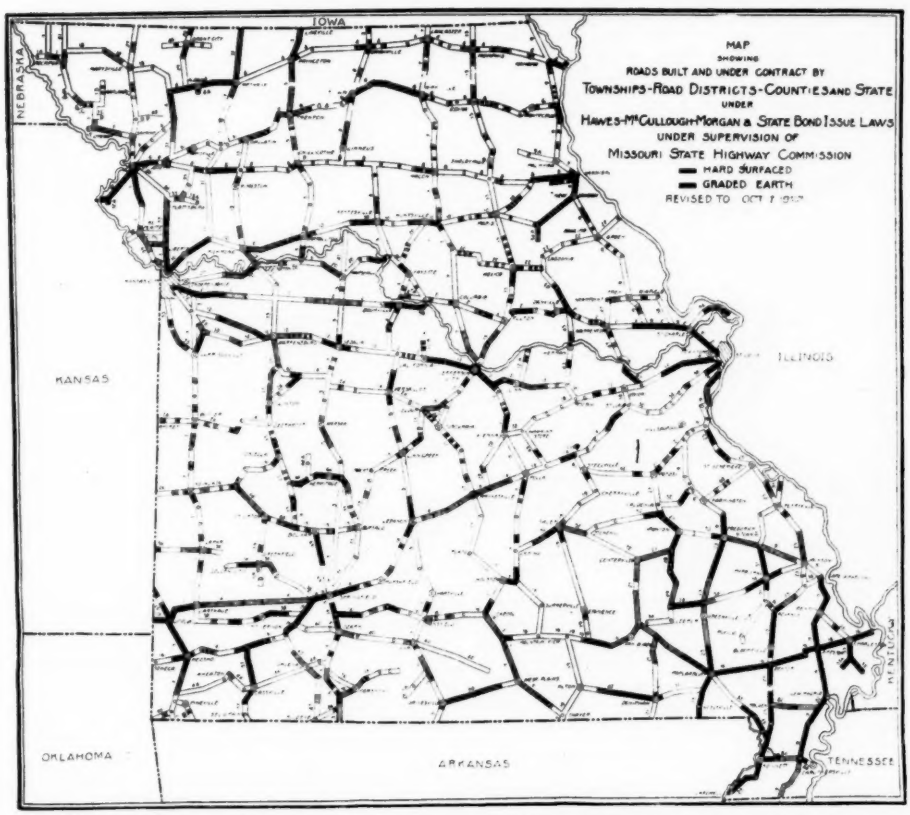
In its entirety, Missouri's road program embraces the construction and maintenance of approximately 7,640 miles of hard surfaced state highways. These highways, forming a connected system, were designated by the State Legislature at a special session in 1921. This system includes the main traveled roads connecting the county seats and all the important centers of population and comprises nearly 7 per cent of the total road mileage in Missouri.

Provision was made in the law creating the system for the selection, by the Highway Commission, of certain preferred routes for improvement with higher type surfaces, in order thereby to serve economically the heavier and denser traffic. In its selection of these higher type, or primary roads, the commission was authorized to deviate from statutory designations in the interest of economy and directness of route between important centers of population.

The remaining part of the highway system, known as secondary roads, is defined by the statute, and little or no option is given the commission to vary from this statutory designation. The completion of this entire program is a very large undertaking.

At present the Highway Department is directly concerned with the expenditure, insofar as it may go, of a $60,000,000 bond issue, assisted by some undetermined amount of federal aid, toward the completion of the state highway system. Some of the work previously done by the Highway Department in earlier years will be available as parts of this more recent designated state system. This earlier work was carried on by funds raised by the counties, the state, and a goodly portion of federal aid.

To give the road program an impetus and the Highway Department a more



MAP SHOWING COMPLETED MISSOURI STATE HIGHWAY PROJECTS AND THOSE UNDER CONTRACT AS OF OCT. 1, 1923

Solid Lines Show Hard Surfaced and Shaded Lines Graded Earth Roads

direct initiative and control of the state highway system, a bond issue of $60,000,000 was authorized by an amendment to the constitution carried by a vote of the people. Provision was made to pay the interest and sinking fund charges out of the annual fees collected for automobile licenses. These bonds were to be issued annually in amounts not exceeding the statutory limitations until the entire $60,000,000 had been sold.

The first issue was that of Sept. 1, 1922, for $5,000,000. The second issue was that of Dec. 1, 1922, also for $5,000,000. The next issue occurred Nov. 1, 1923, for a similar amount. As provided by law, the proceeds from these bond sales are divided between the primary and secondary roads, so that the primary system secures one-third plus $6,000 per mile of primary roads. The remaining portion of the bond issue money is allotted to the secondary roads. Federal aid funds available are apportioned one-third to primary and two-thirds to secondary. On this basis there will be available for the 1,540 mile primary system, out of the entire bond issue, $29,240,000, or an average of about $20,000 per mile. For the secondary system, covering 6,100 miles, there will be available from the entire bond issue, $30,760,000. The residual amount of federal aid allotments available for the state highway system was, at the time of issuing our first bonds, $6,441,488. This allotment will hold good until June 30, 1925, after which date the amount of federal aid available is a matter of conjecture, for Congress has not yet made appropriations beyond that date. The state secondary system has been estimated to cost $108,689,000. From this is readily seen that the present program will fall short of completing the entire system.

Moreover, the law provides that work shall be done simultaneously in the 114 counties of the state, and that each county shall receive its proportionate part of the mileage allotted it. It is obvious that a number of detached, disconnected road projects, even though completed, will not serve state-wide traffic. This may be overcome to a degree by the concentration of effort and money on a few of the primary roads connecting the most important population centers and thereby furnishing a measure of service to the state-wide traffic.

The accompanying map shows the location of our state roads, the projects that have been completed, and that are now under contract. Distinction is made, by means of shading, between the hard surfaced roads and the graded earth. It has been the policy of the commission to do a large amount of grading, so that the embankments would have time to settle, and the entire road be packed by the traffic before it is surfaced.

STATUS OF MISSOURI STATE ROAD PROGRAM OCT. 1, 1923

	Miles	Value
Total Commitments	3,022.099	$41,771,134.65
Projects completed	1,256.640	13,860,831.32
Proj. now under cont.	1,765.459	$27,910,303.33
Detail of Projects Completed—		
Graded earth	651	4,875,971.60
Hard surfaced	606	8,984,859.72
	1,257	$13,860,831.32
Detail of Projects Under Contract—		
Graded earth	944	$ 8,528,581.15
Hard surfaced	821	15,884,835.36
	1,765	24,413,416.51
Bridges		3,496,886.82
		$27,910,303.33
Detail of Road Mileage Completed—		
Graded earth	1,094	$ 5,686,000.00
Hard surfaced	918	16,017,100.00
	2,012	$21,705,900.00

Total mileage in state highway systems, 7,640 miles.

From the accompanying statistical table, it is seen that our entire commitments, to date, approach $42,000,000. Of these commitments nearly $13,000,000 worth are covered by bond issue funds.

In addition to the construction program, the department has inaugurated, during the past year, a maintenance program and an organization to put it into effect. The policy of the department is to maintain existing traveled roads now on or approximating the routes of the state system. This gives immediate service to traffic and serves to keep roads passable while construction work is under way.

MODERN STREET LIGHTING

By C. F. Lambert, of Burns & McDonnell Engineering Co., Interstate Bldg., Kansas City, Mo.

Few people, not directly concerned in the lighting of streets, are consciously aware of the remarkable developments and improvements which have taken place in this connection within a comparatively few years. It is only observed by one who, accustomed to the splendid

illumination of a well-lighted city, visits a city whose street lights show a backwardness in keeping up with the pace of modern progress. The progress of a city in business, in attractiveness and in welfare is measured by its civic improvements. The original object in street lighting was to enable traffic to function without collisions or interference. Now, however, street lighting is an important element in crime prevention, a trade stimulant, and a means of expressing civic pride. That there is a direct bearing upon business development is shown by the active interest shown by Chambers of Commerce and other trade bodies in hundreds of cities, in the construction of brilliant illumination for their business sections. Large sums of money have been expended in this way by such bodies acting in conjunction with city authorities and electric lighting companies. The popular "White Way" lighting, which is almost universal now, had its inception through realization of the importance of good lighting as a trade factor. In many cases it has been the means of inducing people to pay regular visits from outlying districts to these brilliantly lighted cities, who came before only as necessity demanded.

Two Methods of Street Illumination

There are, generally speaking, two methods of street illumination: First, the high intensity lighting found in business sections of cities, which require an illumination sufficient to enable a large and fast moving volume of traffic to be handled without accident; second, low intensity and uneven lighting, as found in residence sections where objects, vehicles, etc., are seen in silhouette—usually as dark outlines against an illuminated street surface. As these streets are frequently lined with trees, it is necessary to place lights low to avoid the foliage. Therefore, residence streets are generally lighted to better advantage with low power lights at fairly close intervals, than by high power lamps at street intersections only. Generally, about three-fourths of the total lengths of streets in a city fall within this class. The still further outlying districts require merely a line of lights to indicate the way to travelers, and no effort is made for direct illumination.

Many Compromises Necessary

The many factors entering into the problem of street lighting require many compromises in attaining the final result. The desirability of a uniform design throughout a city should not be overlooked, especially in the lighting of a long thoroughfare which may extend from a business center to the outskirts. In such a case it may be necessary to sacrifice the requirements of certain sections, to some extent, to produce the proper effect for the whole. One factor that is frequently overlooked is the color of the street surface. The oiling of streets which had a light colored surface, frequently causes complaint of the street lighting and it is not always realized that the lower intensity is due to reduced effectiveness of the lighting with the dark streets.

Local Conditions Govern

Local conditions govern, to a large extent, the requirements for laying out a street lighting installation, and no definite rules can be made covering all cases. The amount and distribution of the light, the size of unit to be employed and the height and spacing of the lamps are all related and must be considered with other factors. Where there is no foliage, lamps should be placed well above the ground so that the maximum illuminated may be obtained at distant points. Care must be exercised, however, that the lamps are not mounted too high, as the uniformity would be gained at a sacrifice of intensity. The limiting factor for height and spacing is the amount of light obtained midway between the light sources.

Candle Power

When pendant or hanger types of units are used along the curb, lamps up to 100 candle-power should be mounted from 15 to 18 ft. high, depending somewhat on the light distribution. The higher candle-power sizes, i. e. 400, 600 and 1,000 candle-power, should be suspended at a height of from 20 to 25 ft. The spacing depends upon the uniformity of the illumination desired, and should seldom be greater than ten times the mounting height.

Lamp Spacing

For wide streets, lamps placed opposite one another will present the neatest appearance.

The staggered arrangement of lamps is sometimes advantageous in giving a uniform illumination, but will not be so attractive in appearance as where the lamps are placed directly opposite each other.

The arrangement of poles on one side of a narrow street is often very effective and economical, and is especially applic-

able to the lighting of parkways and suburban or residence streets. This arrangement is not suitable, however, for commercial streets.

In the low intensity lighting it is important that lamps be located at all street intersections; but with ornamental post systems, it is not desirable to place lamps directly on the corner, as the glare from such a lamp will tend to blind the driver who is about to turn the corner and wishes to see if the way be clear.

Care should be taken in any street lighting that the lamps appear in a continuous line, as any irregular placing of lights will detract greatly from the effect.

Intensity of Illumination

No definite figures have been generally accepted for determining the intensities of illumination most desired, and methods of comparing intensities of illumination of different types of light have not been standardized.

The final determination of intensity for street lighting depends upon the cost, and many other factors such as the surroundings and other local conditions. Comparison of practice in various sections and cities are useful in this connection. For similar units such comparisons may be made in watts per running foot of street; otherwise illumination or candle-power value of the same order may be utilized.

The proper diffusion of light by means of diffusing globes and refractors, is important in reducing the glare from bright light sources coming directly in the range of vision, and also eliminates the deep shadows. This is becoming of greater importance every day, due to the increasing brilliancy of modern illumination. The appearance of a light source is also greatly improved by the use of such equipment.

There are many different types of street lighting, including high and low candle-power pendant units, suspended from brackets or span wires, and ornamental post lighting with both high and low candle-power lamps. The system of energy supply to the lamps may be either multiple or series. Both systems can be installed underground or overhead. Of course, the greatest number of systems in this country are operated on the overhead series system.

The cost of installation and operation of street lighting systems is governed entirely by local conditions, and one is quite likely to be led to wrong conclusions if comparison is made of the prices charged in different cities, without a full knowledge of the local situation.

Important Details

Sizes of series lamps available for street lighting vary from 32 candle-power to 1,000 candle-power for use on a 6.6 or 7.5 ampere alternating current circuit. As the high candle-power lamps can be operated more economically at high currents, the units for the larger lamps are usually equipped with compensators or transformers. This permits their use in series with the smaller lamps.

Much skill has been shown in lighting of roads and highways. These are now being lighted by equipment which collects the rays and throws them up and down the road where needed. These units are mounted 30 to 35 ft. above the road and the glare which might naturally be expected to result is not apparent. The illumination of 250 candle-power units is excellent when placed 300 ft. apart and the lighting is good at even twice that distance.

At the intersections of highways, high powered flood lighting projectors are sometimes installed. They must be installed so that no glare reaches the motorists.

For outlying residence districts 40 to 100 candle-power lamps are popular and their height and spacing are adjusted to meet the conditions.

For the main residential section the lighting should be somewhat increased and lamps of 100 to 400 candle-power are utilized. A general plane of illumination comparable with that of bright moonlight and ranging from 1/20 foot candle to half or third of that amount is usually sufficient.

Summer resorts and cities having a high seasonal percentage of transient population require a highly ornamental type of residential street lighting fixture. This can be arranged so that a distinctive ornamental system may be had four months in the year and an adequate and economical system the balance of the time.

Business Street Lighting

In the main business section the art of street lighting has been most fully developed. Here the plane of illumination should be carried near to one-tenth foot candle, ranging perhaps from half of this amount at the darkest spots to at least double near the lamp. The most important streets and public places ought to

have an average of a good quarter-of-a-foot candle, giving light enough to read a notebook. Such lighting ought to be furnished in places out-of-doors where the public gathers at night, and in streets where the traffic is dense or the requirements for policing exceptionally severe.

In order to obtain the greatest usefulness and the most brilliant results, along a business street, most of the lights should be cut off from vainly trying to illuminate the sky. The buildings along the street should be well lighted from the street lamps and the street surface should be sufficiently illuminated to permit traffic to see clearly. Powerful arcs or large incandescent lamps placed fairly high, 18 to 20 ft., and spaced at a distance not over four or five times their height are very effective in securing these results.

In selecting the design of a standard for street lighting, local features and historic tradition can often be utilized. For instance, Los Angeles, Calif., has adopted a style suggesting the Spanish Renaissance. Riverside, Calif., has accentuated the Mission features of her spirit by installing a rough concrete post in the form of a chapel bell tower with three mission bells hung in a triangle, and a cross at the top of the design.

The requirements of cities which are far from the source of supply of standard globes, can be met with the lantern type of unit.

Thus, in modern street lighting the work of the architect and artist keeps pace with that of the electrical and illuminating engineer, so that every city may acquire a lighting system which will be adequate for the illumination required, and will be the pride of the entire community.

The foregoing is from a paper by Mr. Lambert before the 1923 Convention of the Municipal League of Indiana.

ROADWAY WIDTHS AS RELATED TO TRAFFIC

By L. R. Ash, of Harrington, Howard and Ash, Consulting Engineers, 1012 Baltimore Ave., Kansas City, Mo.

Traffic must go in lanes and the number of such lanes will be determined by the volume of traffic. On country highways and city streets the traffic follows the center of the roadway except when passing other traffic or when the traffic is dense enough to make turning out more troublesome than to keep continuously to one side of the road.

One Lane Pavement

In perhaps a majority of the highways of this country, except in the more densely populated districts, a 9 or 10-ft. pavement would be ample if shoulders were provided and maintained which would permit vehicles to pass. With a rule requiring the lighter vehicle to yield the road to the heavier, shoulders would be entirely adequate in the great majority of cases on the less densely traveled roadways. The writer recently traveled scores of miles on a highway in one of our southern states which has a paved roadway only 9 ft. wide. Although this highway carries rather heavy tourist traffic, during certain seasons of the year, little inconvenience was experienced in driving on it except for the lack of proper shoulders for passing other traffic. On this highway it was difficult many times to regain the pavement after having turned out to pass another vehicle. Proper shoulders which could be maintained at reasonable cost and which would add greatly to the stability of the pavement, would make this 9-ft. roadway adequate for present traffic. Very soon, however, the traffic on this highway will increase to such volume as to justify widening the pavement, but the road has given good service for many years and undoubtedly it was originally well planned and the 9-ft. pavement was the proper thing. A 9-ft. paved or gravel way would be a great boon to many communities which are struggling with the mud while awaiting the time when they will feel equal to the construction of wider pavements. A roadway 9 ft. wide, if properly designed and built, can be widened when the traffic demands it with the loss of only a small part of the cost of a pavement of standard width.

Two Lines of Traffic

When we pass from one to two lines of traffic, a roadway should be at least 16 ft. and preferably 18 ft. wide or even 20 ft. in some instances. If all vehicles traveled at the same speed the problem would be greatly simplified and a roadway 18 ft. wide would carry a traffic limited only by the miles per hour of travel. It is the necessity for making provision for the faster moving vehicles to pass the slower ones that complicates the situation. Since the rules of the road require that the faster moving vehicles, in passing other traffic in the same direction, give the right of way to traffic

in the opposite direction, the fast vehicle is forced to take advantage of gaps in the traffic which it meets. Fortunately, traffic has the tendency to form in groups, thus lengthening the gaps available for passage. Roadways designed for two lanes will carry a surprisingly large amount of traffic and undoubtedly the two lane roadway will carry more traffic per foot of width than any other. Recently the writer traveled about 100 miles on a concrete roadway 16 ft. wide, when there were probably 1,500 vehicles passing a given point each hour. The traffic was about the same in both directions. Of course there was some inconvenience from having to wait for a chance to pass more slowly moving vehicles, but the delay was not serious and had the shoulders on this road been in proper trim, the inconvenience would have been negligible.

Three Lines of Traffic

On a roadway wide enough for three lanes of traffic, one lane is really to facilitate the passing of the faster moving vehicles, unless the traffic in one direction largely predominates, in which case two lanes of traffic can be maintained and the third lane is for opposite travel and for passing. Very often we find roadways of widths that result in a very inefficient use of the pavement. For example, a roadway 22 to 26 ft. in width is only a liberal provision for two lanes of traffic, but is not adequate for three lanes. This wastefulness is especially aggravated if the roadway is on a bridge or viaduct, which is very expensive. For fast moving, modern traffic, a roadway 20 ft. wide is abundantly ample for two lanes of travel and it is a mistake to build a roadway 22, 24 or 26 ft. wide, since the result is still only two lanes of travel. The minimum width for three lanes of traffic should be 28 ft. and from 30 to 32 ft. is a liberal provision for three lanes. A roadway 34, 36 or even 38 ft. wide simply provides extravagantly for three lanes but is not adequate for four lanes.

As the lanes of traffic multiply, the resulting confusion requires a more liberal width for each lane. For instance, double the width necessary for two lanes will not provide equally adequate facilities for four lanes. A viaduct in one of our middle western cities, about 1½ miles long, has a roadway 30 ft. wide for about two-thirds of its length and 38 ft. wide for the remainder. A study of the rather heavy traffic on this structure demonstrates the inefficiency of a roadway 38 ft. wide as compared with one 30 ft. Traffic on this structure is never found in four lanes, although frequently the traffic is dense enough to utilize four lanes if the roadway were of the proper width. The roadway on this viaduct has handrails at the curb lines and it should be remarked in passing that a handrail or fence has the effect of reducing the effective width of a roadway..

A three lane roadway will accommodate a surprisingly large amount of traffic. A bridge in a New England state was recently completed having a roadway approximately one-half mile long and 28 ft. between curbs, there being a rail or fence along each side for the entire length. The resident engineer on the work reported that on the Sunday preceding last Labor Day over 10,000 and on Labor Day over 11,000 automobiles, other vehicles not counted, passed over the structure. The report states that this large amount of traffic was accommodated with a fair degree of comfort.

Forty feet is about the least width that should be considered for four lanes of traffic and for this and greater widths, the comfortable use of the roadway will be greatly enhanced by marking the lanes with painted lines or other means. This greatly diminishes confusion and prevents one lane from encroaching upon another's area.

After passing 40 ft. it is doubtful if the increments of width should be less than 20 ft., for on such heavily traveled thoroughfares the use of an odd lane is likely to be confusing and traffic so dense as to over-crowd a 40-ft. roadway will be none too comfortably cared for on a width of 60 ft. when due allowance is made for the natural increase of traffic.

Effect of Fences and Shoulders

On all roadways the condition at the side of the pavement with reference to fences or shoulders will materially affect the capacity. This is especially true on bridges and viaducts having fences or handrails. Drivers will not travel as close to a handrail or a fence as they will to the edge of the pavement, where there is no such construction. A roadway of given width with a sidewalk on either side will be used with greater facility than if there is a fence alongside. From observing traffic on roadways with handrails or fences, it would seem conserva-

tive to allow 2 ft. more in width where these are found than when they are omitted if traffic is allowed equal freedom in both cases. Also, if shoulders are maintained to the pavement level, traffic will pass more closely to the edge of the pavement or will even drive onto the shoulder, thus greatly facilitating the passing of vehicles.

Effects of Car Tracks and Vehicle Parking

What has been said thus far applies to roadways upon which there are no street car tracks and where parking is not allowed. Where there is one street car track and parking is allowed, the minimum width of roadway should be 44 ft. This allows 10 ft. for the car, 10 ft. for a lane of travel on either side of the car, and 7 ft. along either side of the street for parallel parking. Where there are two lines of street railway, the minimum width between curbs should be 54 ft. if parking is to be allowed. These widths will provide sufficient roadway for heavily traveled streets and where traffic is so dense as to require greater widths the increments should be not less than 20 ft. If there are no car tracks and parking is allowed, 14 or 16 ft. should be added to those widths designed for one, two, three, etc., lanes of travel. The minimum width of a street should be 24 and preferably 26 ft., assuming that parking will be allowed, and if a wider street is desired these widths should be increased by increments of 10 ft.

One-Way Traffic

In many cities the traffic has so outgrown the street widths that a remedy is sought in one-way traffic. Where the street has but one car line often this is a good solution, but where there are two car lines many difficult and dangerous situations arise with one-way traffic. Very often a rearrangement of street car lines would eliminate one track and thus make one-way traffic not only feasible but greatly advantageous over conditions where there is great congestion. A street so congested as to force traffic to move slowly will handle many fewer vehicles than would be possible on even a narrower street if the traffic lanes were kept open and traffic could move at a reasonable speed. Many times parking along the curb robs the street of its traffic capacity and changes the character of the district. Merchants have been known to object to the elimination of parking for fear it would curtail trade, when the real result has been to obstruct the roadway and add another strong inducement to trade in the suburban store. Nothing is so attractive to traffic as an unobstructed thoroughfare and it is quick to find it. Recently a street in Kansas City was practically deserted and the merchants were discouraged. After widening the roadway and repaving, the traffic is so dense that already traffic policemen are necessary to direct it.

Certain downtown streets in nearly every city are very properly used for parking and in this way they serve a most useful purpose, but the moment such use interferes with the free movement of traffic, parking should be prohibited and the streets which are kept open will be the popular streets. Narrow streets are causing a loss in business real estate in many cities out of all proportion to what an adequate street width would have cost had it been widened at the proper time.

There is every reason to expect a continued increase in the number of automobiles and the difficulty of providing adequate space for them will increase correspondingly. More and more congested areas must be kept free from the parked car and where possible the roadway width should be changed to permit automobile traffic to move at proper speeds. Often this can be done by moving curbs back 2 or 3 ft. on either side of the street and thus provide a width that will permit a speed of 15 to 20 miles per hour instead of 8 or 10. Street areas are expensive and the widths adopted should certainly be determined by the known requirements of modern traffic.

The foregoing matter is from a paper by Mr. Ash presented at the recent convention of the American Society for Municipal Improvements.

STREAM LINE FILTERS

By George W. Fuller, Consulting Engineer, 170 Broadway, New York, N. Y.

Stream line filters were one of the most interesting exhibits at the Shipping, Engineering and Machinery Exhibition at Olympia, London, last month. They are the invention of H. S. Hele-Shaw, D.Sc., LL.D., F.R.S., a well-known inventor of mechanical appliances, a distinguished professor of engineering in earlier years at Liverpool and in South Africa, and last year President of the British Institution of Mechanical Engineers.

Historical

The principle of this filter was discovered last winter while experimenting with lantern projections to indicate the behavior of films under pressure in connection with the Theory of Stream-Line Motion, established by Dr. Hele-Shaw. Announcement of the discovery was made before the Royal Society May 10, 1923, and the formal paper attracted so much interest that this society requested a demonstration of its practical application at its annual soiree on May 16. So intense was the interest in the use of this highly scientific discovery that a second demonstration was given by request of the Royal Society on June 12. Descriptions and demonstrations were also given before the Royal Institution on June 1, before the Society of Chemical Industry on June 4, when a commercial-size filter was first shown, and before the Institution of Civil Engineers on July 12. So much for the antecedents of this device, which had been patented, prior to its exhibition before the general public at Olympia, August 31 to Sept. 22, 1923.

Operating Principle

The stream-line filter in its simplest form is made of a pack of specially prepared paper, impervious to water and oil and somewhat roughened to provide passage-ways, the pack being held within a container between two press-heads. One of the press-heads is movable and provided with a screen arrangement for suitably compressing the many hundreds of sheets which make up the paper pack. Through the entire pack from press-head to press-head are two alternate sets of circular holes, the larger being for the influent and the smaller for the effluent. At one press-head are channels through which, under pressure as desired, the influent is led to each of the openings of larger diameter; and at the other press-head are channels connecting with the smaller holes in order to remove the effluent. The influent, even under heavy pressure, can pass from the larger tubular openings only through the laminae of the heavily compacted pieces of paper, with stream line motion, into the smaller tubular openings which form an exit from the filter. The latter is equipped, at the press-heads, with rubber joints and other minor arrangements, which vary with the size of the unit and need no description here.

These filters are built of the horizontal or vertical type. The largest stream line filter exhibited at Olympia consisted of a battery of 16 vertical filters, each pack containing 16,000 sheets, 256,000 sheets in all, with 32 influent openings making the total number of filter units 8,192,000. Its rated capacity is 10,000 gals. per hour.

Cleaning

Stream line filters require cleaning at intervals, depending upon the quantity and quality of influent filtered since the preceding cleaning. This is done in one or both of two ways. Either the deposit on the walls of influent tubular openings is pushed through suitable ports in the press-head by means of light, free-fitting pistons which are actuated by the pressure normally used in forcing the influent through the filter; or, the deposit is removed by forcing the effluent back through the effluent openings, through the laminae of the compressed paper pack, thence through the walls of the influent tubular openings and out through a suitable port. Obviously the cleaning operations are to be adjusted to the work done by the filter. That is, consideration is given to whether the purpose is to obtain the separation of solids or colloids, or to free a liquid of undesirable matters contained in it. I saw several packs of paper dismantled after more or less use in filtering various substances and I was impressed by the complete absence of stain or other sign of service by the paper, other than at the edges of the influent openings.

Accomplishments of edge filtration, as distinguished from ordinary filtration through a body of granular material, depend upon the ability to regulate the attenuation of the films in which the liquid passes in stream-line motion. It is essential that the material used in this new filter have a rough surface so as to provide passage-ways, as satisfactory results do not appear to be obtainable with smooth surfaces. The special paper now used is not only impervious and relatively cheap, but its flexibility allows pressure to be applied to the packs in varying degree, thus providing a control for the size of the passage-ways. As a result of passing certain mixed liquids through the stream line filter several times, and increasing the pressure on the paper pack between each filtration, it is understood that different substances are removed each time, thus accomplishing what for convenience has

been designated as "fractional filtration." It may be mentioned that the paper in use is said to withstand ordinary acid solutions up to 10 per cent strength, but that filtration is interfered with by alkalies approaching 1 per cent.

Work of the Filter

As to the work which the stream-line filter will do, it is not easy in a few words to do justice to the discovery of Dr. Hele-Shaw. For present purposes it is sufficient to record some of its accomplishments, as follows:

Removes the color or stain from moorland swampy water.

Produces a colorless effluent from a solution of Erythrosin when diluted with 5,000,000 parts of water, and having a brilliant orange color with fluorescent green glint.

Produces from milk a clear effluent, nearly tasteless.

Extracts the oil from feed water.

Separates water and impurities from oil.

Extracts 30 per cent of the salt in sea water.

Decolorizes unrefined sugar.

Separates cyanogen from gas house sludge.

Reduces dilute activated sludge to a 60 per cent water content.

Enough has been said to indicate the wide range in style of performance which may be obtained from this discovery of Dr. Hele-Shaw. I have never seen an invention which has attracted so much favorable attention from such widely different groups of men. Its accomplishments have aroused not only those engaged in scientific investigations, but also the engineer, the chemist, the bacteriologist and the manufacturers engaged in many industries. Its commercial uses are being eagerly investigated at the same time that laboratory men are discussing its utility in their work. Discussions by English scientists have already suggested many interesting possibilities, including the grading of bacteria of different sizes, the concentration of enzyme solutions and the separation (by using sufficient pressure) of ultra-microscopic micro-organisms.

It is too early, of course, to say much as to the economic worth of this filter in the industries or to outline the scope of its benefits to science. But the indications are that it will have a bright future along many lines of activity.

As I left London a couple of weeks ago I was informed that an American company, to develop this invention in this country, was about to be formed, and that perhaps arrangements would be made to demonstrate its performance at the National Exposition of Power and Mechanical Engineering at the Grand Central Palace in New York, during the first week in December. However, announcements as to its introduction in this country will have to come from those having the matter directly in hand.

The foregoing paper by Mr. Fuller was read Oct. 16, 1923, at a meeting of the Engineers' Club of Philadelphia devoted to a discussion of the Pollution of Streams by Industrial Wastes.

HIGHWAY TRANSPORT, AN AID TO THE RAILROADS*

By Arthur H. Blanchard, President National Highway Traffic Association, and Professor of Highway Engineering and Highway Transport, University of Michigan, Ann Arbor, Michigan.

One of the most potent factors in the development of agriculture and industries, the growth of cities, the increase in wealth of states, and in the establishment of a sound basis for national prosperity is the efficient co-ordination of our railway, waterway, airway, and highway systems. Only by the development of a sound economic interrelationship between these four systems, will we obtain low rates, which will yield a reasonable return to the operators, and transportation facilities of maximum benefit to the public. It is of no benefit if a million bushels of grain have been produced in Kansas, if that grain can not be carried to market. As Senator Ransdell from Louisiana has said, "Prosperity is not helped because a bumper production of this or that is brought into existence, if transportation means be lacking to move it promptly and at reasonable charge to those who require it." The late Professor Alexander Graham Bell tersely summarized the value of our systems of communication when he said that "Transportation is the very blood-stream of civilization."

In this address will be found several quotations. It is, of course, practicable to express all of the opinions and con-

* Address delivered at the Joint Session of the North Central Division of the National Highway Traffic Association and the Michigan State Good Roads Association in the Auditorium of the Michigan Agricultural College on Nov. 6, 1923.

clusions as personal views as the speaker has quoted no statements with which he is not in accord. In a brief discussion on a subject which today is controversial in the public mind, it appears worth while to bring to your attention the views of men prominent in National affairs or occupying positions of responsibility in the transportation world.

Views of Railway Leaders

About 15 years ago, James J. Hill, that pioneer in railroading, stated before a Committee of Congress that "Transportation demand was increasing so rapidly the railroads were unable to keep pace with it, and that in the near future our transportation facilities would collapse under the burden if we continued to rely solely upon the railroads to carry all the things that people produce." Vice-President Elisha Lee, of the Pennsylvania Railroad, has declared that "The next time our company has a real revival in business, we shall come, in all probability, to be confronted with the most severe congestion of railroad traffic and the most inadequate railroad facilities in our history. When that happens, rates will be lost sight of. Everyone will be clamoring for service. The whole country will demand transportation at any price; and rates will become so high they will cause great economic waste." On Jan. 20, 1923, Representative Newton of Missouri, on the floor of Congress, made this declaration: "The most serious commercial problem confronting the American people today is the problem of transportation. Our industries can not develop beyond the limits of our transportation facilities. When you shut down the machinery for transportation, you paralyze the industries of the country."

Railway and Waterway Transportation

In discussing the present interrelationship between railway and waterway transportation, Mr. Logan G. McPherson said in 1910 that "In the United States the railways demonstrated their superiority not only over the canals, but also over the rivers, in large measure displacing even the steamboats for which the Ohio and Mississippi rivers and their tributaries were famous."

This is a correct statement. Let us diagnose the methods by which it was accomplished. The following findings of the Inland Waterways Commission afford us the desired searchlight:

"While the decline of navigation in the inland waterways was largely due to the natural growth and legitimate competition attending railway extension, it is also clear that railway interests have been successfully directed against the normal maintenance and development of water traffic by control of water-fronts and terminals, by acquisition or control of competing canals and vessels, by discriminating tariffs, by rebates, by adverse placement of tracks and structures, and by other means.

"So large a portion of railway traffic is free from water competition that railways can readily afford so to reduce rates on those portions affected by such competition as to destroy the profits of the water lines without appreciably affecting the profits of the rail systems which recoup these reductions by higher rates elsewhere."

Attitude of Railway Officials Toward Highway Transport

What is the present attitude of railroad officials in the United States toward the development of highway transport? The answer is not a simple one to formulate as many diverse opinions have been expressed in words and actions. Some of our railroad officials appreciate the intrinsic value of highway transport and have made use of it as a part of their own transportation systems. Others have advocated its development because they know that it is necessaryt o the success of their business that facilities should be provided for economically transporting goods over highways to be later carried by railways. Others have been concerned regarding the development of highway transport from the standpoint of destructive competition with railroad transportation and have endeavored to curtail its development through legislative action. Others, and it is hoped that there are only a few in this class, have considered the subject from such a narrow viewpoint that they have advocated a curtailment of highway improvement.

Do we need to go further to realize the vital character of the problem we have under discussion and the necessity of developing in the minds of the people, our representatives in legislative halls and the operators of the four great systems of transportation that only through co-ordination of all and the enactment of legislation which will permit the efficient development of each agency will the public welfare best be served?

An Aid to Railroads

It may appear audacious to announce

bluntly that highway transport is an aid to the railroads, especially in view of statements frequently appearing such as that of one railroad president who charged a deficit of $4,856,000 to motor vehicle competition. Bald conclusions of this character appearing in the public press bring to the mind of the reader the much maligned motor truck tearing up the public highways. The public does not analyze the true meaning of the loss in revenue. It does not appreciate the large percentage of reduction of railroad receipts due to the operation of the family motor car. It does not know that some railroads are experiencing a reduction in gross revenue but would not suffer a loss in net profits provided that they efficiently used their facilities for the handling of those phases of transportation for which they are pre-eminently adapted to handle profitably.

The Lessons of History

The average citizen has lost sight of the usual consequences which follow the development of a new mechanical invention of benefit to mankind and the use of which contributes to national progress. Many railroad officials appear to have forgotten what happened to canal and river traffic and profitable commercial highway transport in the days when stages constituted the only common carrier for overland transportation. The disastrous effect on the balance sheets of canals, river and stage companies of the laying of hundreds of miles of rails wherever there was an evident field for bulk or mass transportation is a chapter in the story of railroading known to all.

Railroads Vital Part of Transportation System

Railroads are not going to cease to function because of the development of highway transport. The railways are and always will be a vital part of our transportation system. They, however, have an economic field which has clearly been defined by Professor Henry E. Riggs of the University of Michigan when he said at a convention of the National Highway Traffic Association that "Railway transportation for long distance business, and for all carload business where there is direct track connection to the factory or warehouse of the shipper is and always will be more economical than any form of highway traffic." The writer is an optimist and therefore believes that the American railroad official will see the light shining from the beacons of publicity and dissemination of knowledge and will soon administer his system of transportation with full recognition of the true value of highway transport to the railroads and the part which it will play in national development.

Feeders to Rail Lines

The railroads can render immediate valuable service to the public and to themselves by helping to direct the development of highway transport as feeders to rail lines and as extensions of rail service. A correct and immediate solution of the interrelationship between these two links of our national distribution system is very desirable in the interests of public welfare.

How Railroads Can Use Highway Transport

What are the opportunities for the railroad to function as an operator or user of highway transport?

First: The transportation of freight by motor trucks from one railway terminal to another in the same or nearby city. The advantages of the utilization of highway transport, as compared with the tedious method of rail transportation by "trap" or "transfer" cars over congested tracks have been appreciated by a few railroad officials. It has been established in some cities, notable examples being found in Cincinnati and St. Louis.

Second: The organized delivery with motor trucks of carload freight from public team tracks in large terminal areas. With such a system in effect, it has been stated that the present freight car equipment of the railroads would be sufficient to meet all transportation needs for several years to come.

Third: Extension of transportation service through the medium of motor truck and motor bus routes. There are several methods of development practicable in this field. Urban and interurban electric railway lines may logically expand their passenger transportation facilities through the establishment of tributary motor bus routes. During 1922 sixty electric lines throughout the United States used motor buses to supplement their rail service. Steam railroads may enter this field through the development of intercity and rural motor express lines to carry both commodities and passengers. One of the most notable examples is afforded by the highway transport services of the Great North of Scotland Railway Company which established its first motor truck service in 1904. In 1921

this railway company was operating five passenger routes and seven intercity motor truck routes. Railroads having stations in scenic areas may well give consideration to another development by the Great North of Scotland Railway Company, which operates from Aberdeen a motor bus line for tourist traffic.

Fourth: The collection and delivery of freight in municipalities and adjoining areas, which is similar to the methods universally employed in large cities for handling express shipments. This phase of highway transport would be a development of what is commonly known as the store door delivery plan. The ruling of the Interstate Commerce Commission in the case of the Baltimore development along this line means that it is impracticable for interstate railroads at present to use their own trucks in this manner except on such a large scale that the charge of discrimination in services rendered could not be brought against them. It is possible, however, to arrange with a large trucking organization to render this service. A development in Michigan is the plan of the Detroit United Railway to establish a pickup and delivery system with motor trucks especially equipped to carry box containers, one or more containers being used for the freight of one shipper. In England, we find railroads functioning as operators of highway transport in this field. One of the most notable examples is the case of the London & Northwestern Railroad's comprehensive system of freight delivery by motor trucks in areas with headquarters at London, Birmingham, Manchester, Liverpool and Leeds. This railroad established its highway transport service in 1905. In 1920 it was operating over 350 motor vehicles.

Branch Lines of Railroads

W. H. Lyford, Vice-President of the Chicago & Eastern Illinois Railway Company, believes that another field for the profitable use of the motor truck is the transportation of freight between communities which are served by branch lines of railway on which the traffic is too light to pay the expenses of any kind of railway transportation. He further says that no more such branch lines ought to be constructed if the highway transport operator will take over this field and occupy it intelligently and efficiently, and that money-losing branch lines along which transportation by motor truck over existing highways could be furnished at less expense should be abandoned.

To cut down operating costs on branch lines, 40 steam railroads are now using flanged wheel motor buses. Another development may be the reconstruction of the railroad roadbed as a private highway for the use of the railway company's trucks and trailers or its operation as a toll-road, which, if properly constructed without grade crossings for four lanes of traffic, could accommodate slow moving trucks and trailers and high speed motor busses.

L. C. L. Short Haul Freight

Elisha Lee, Vice-President of the Pennsylvania Railroad, goes a step further when he states that "The railroads still do a great deal of purely retail business. Some of it perhaps pays its way, but much of it unquestionably entails a loss. In the immediate vicinity of all our highly developed commercial and industrial communities, an immense amount of such traffic originates. A large portion of it moves only a few miles, but in its handling we are obliged to employ the most costly and overworked facilities which the railways own, namely, the yards and terminals in the great centers of industry and population. Here is a real opportunity for the motor truck to demonstrate its utility upon a true economic basis. The reason why less than carload traffic, especially on the shorter hauls, is becoming a growing burden upon the railroads is that we are obliged to use in it terminal facilities and rolling stock which are too expensive for the purpose and which of necessity must be primarily planned and adapted to the handling of bulk traffic, mostly moving over the longer hauls. Therefore I believe it to be at least probable that in many instances the short haul less-than-carload freight traffic could be turned over bodily to motor trucks with resulting advantage to the railroads and the patrons."

The views of state officials on certain phases of the interrelationship between railway and highway transport are indicated by the following excerpts from the 1922 Report of the Committee on "Motor Transportation" to the National Association of Railway and Utilities Commissions:

"Auto truck transportation meets a public demand in the rapid transit of less-than-carload shipments, including the door-to-door delivery element which

railroads have thus far failed to furnish. Railroad companies have exhibited a degree of indifference or slowness bordering on stupidity in recognizing and meeting demands of the public for quicker and more convenient movement of less-than-carload freight.

"It is evident if rail carriers hope to retain their short haul freight traffic, it will be necessary for them to make radical changes, both in service and equipment. Trucks are rendering an astonishing service between shopping centers and outlying trading points. Country merchants prefer direct truck service to the railroads even where the cost of the service is equal, for the reason that the trucks call at the wholesale house, receive the commodities desired and unload them at the store doors. This enables the country merchants to conduct business with a smaller stock of goods, for the reason that new supplies can be obtained conveniently and on short notice through truck service.

"Another respect in which truck service is preferable, is in the movement of household goods from one town or city to another. The principal expense in shipping by rail consists in crating the household goods and preparing them for shipping. In addition to the cost of crating, is that of cartage from the house to the depot and from the depot to the house. Furthermore, these additional handlings increase the loss and damage by breakage. It is difficult, of course, for rail carriers to meet this sort of competition, and thus far they have apparently made no effort to do so."

The cost of crating for railway shipment is well illustrated in the case of the transfer of the Davis Library of Highway Engineering and Highway Transport from Columbia University in New York City to the University of Michigan in Ann Arbor. The contract price for the crating of the library, the contents of which filled one freight car, was $1,000, while if the library had been transferred by motor truck, it would only have been necessary to box books and periodicals, the cost of which was $120. Another illustration is the case of the Remington Typewriter Company, which transports from its factory in Connecticut all of its typewriters consigned to New York City by motor trucks equipped with special compartment bodies. The saving in cost of packing is $1 for each machine or $300 for each truck shipment.

In closing, allow me to transmit to you the following pertinent message from our late President, Warren G. Harding: "The transport facilities of the whole world, whether by rail or by water, or whether represented by the great network of public highways, have been confronted with a most difficult situation for a number of years. It is one which demands the very best and wisest treatment from the standpoint of both the technical and economic and financial authorities. The whole program of transportation—in all its phases it must be regarded as that of a single problem—is among the most pressing and difficult that the entire world is facing today."

RELATION OF DEPTH OF FOUNDATIONS OF PAVEMENTS TO THEIR STRENGTH

By Clarence D. Pollock, Consulting Engineer, Park Row Bldg., New York, N. Y.

The foundation is a very important part of a pavement and is a considerable item in both the first cost and in the maintenance of the pavement and should therefore receive the careful consideration which it deserves. The foundation should be sufficient to transmit the load on the pavement surface to the sub-grade without material deformation and spread the load over a sufficient area of the soil so that its intensity does not exceed the safe bearing power of that soil. Too little attention has been paid to this portion of the pavement in the past, but with the much heavier loads of modern traffic more consideration is being given this matter. The Bureau of Public Roads has made and is now making tests to obtain more data in regard to the behavior of slabs under varying conditions of loading and impact and different conditions of sub-soil, and others have been working along similar lines, but there remains a great deal to be learned concerning this subject.

Manhattan Conditions

An old macadam pavement has proven a good foundation in many cases when it was not necessary to make openings in it for sub-surface structures, but usually in city streets the most satisfactory foundationi s one of Portland cement concrete, commonly mixed in the proportion, by volume, of 1 part cement to 3 parts sand and 6 parts of broken stone or clean washed gravel. This foundation is generally laid either 5 or 6 ins. in depth

upon a well compacted sub-grade. Where the sub-soil is sand or sufficiently porous material to provide good drainage, these depths have proven sufficient even for present-day traffic. For instance, in the Borough of Manhattan, New York City, with 6 in. depth of concrete foundations the Chief Engineer of Highways stated at the paving conference in Philadelphia in October, 1921, that for a considerable period the cost of repairs due to foundation failures had been kept separately and at that time it amounted to less than one-tenth of one per cent of the total cost of repairs per year. Any increase in depth of foundation here would surely be unnecessary and a waste of money.

Some cities have had a tendency to lay heavier foundations, but with good sub-grade material it would seem to be expensive insurance. It is true that New York has generally good sub-soil conditions, but it is an ever changing city and probably has more construction openings made in its pavements per mile per year than any other city. There is frequent settlement of the sub-soil in these cuts, but the concrete usually bridges over the moderate sized ones and carries the traffic. On Fifth Avenue it was found that 6 ins. of concrete foundation had bridged over a span of 6 ft. and had carried the traffic of that heavily traveled thoroughfare safely for years, although buses on that street, when loaded, weigh from eight to ten tons and carry from six to ten tons on the rear axle.

Improving the Subgrade

When the sub-soil is of clay or other material which can not be readily drained, from the present progress of tests it would seem advisable to improve the sub-grade rather than to weight it with a heavier foundation. In considering the bearing power of soils, a dry clay is usually capable of sustaining a load of 5 tons per square foot, but when very wet the same clay may not sustain more than 1 ton per square foot. By excavating a few inches additional and replacing with sandy or gravelly material the load will be spread so that with this and the better drainage a much greater load may be supported.

The foundation can not act as a beam until the sub-soil gives away sufficiently to allow it to act as such. The better the sub-soil, the greater the load required to deform the foundation. The Washington tests show that with the sub-grade support the sustaining power of the concrete foundation varies more nearly as the square of the depth than directly as the depth.

Measurements show that the foundation in transmitting the load to the sub-grade does not transmit it so that the pressure intensity is uniform. The pressure intensity is highest directly under the load, and spreads out over a considerable area, diminishing to nothing at some distance from the load. The intensity of pressure under the load must exceed the bearing value of the soil underneath before the foundation can act as a beam. Even a macadam, bituminous macadam or bituminous concrete foundation will not be deformed until the intensity of pressure directly under the load exceeds the bearing value of the sub-soil. If the load is stationary or if the surface of the pavement is very smooth there will be simply the static pressure, but if the surface of the pavement is a little rough there will be impact and if the surface is quite rough this impact may amount to four to five times the static pressure. This is greatest when the tires are badly worn; with good, well-cushioned tires the impact apparently approaches more nearly the static load, and hence the advisability of scecuring as uniformly smooth a surface to the pavement as possible in order that the impact of moving loads may be eliminated as completely as can be done.

What Tests Show

In the Bureau of Public Roads tests with slabs on wet and dry soils, the impact tests punched through the 4 in. slabs, but those of 6 ins. in depth and greater were simply cracked on up to those 10 ins. thick, which could not be broken by their apparatus even on the wet sub-grades. According to this a thickness of 10 ins. should be sufficiently great to carry any load that might come upon the pavement even with a wet sub-grade which may be more or less plastic. However, we are not so likely to have wet sub-grades in city streets subject to heavy truck traffic as the pavement is usually impervious to water and likewise the sidewalks are generally paved so that there is much less likelihood of sub-soil troubles here than with suburban roads. But should there be bad sub-soil conditions, in general it will be found much less expensive to improve the sub-grade than to pay for 4 extra inches of concrete in addition to the extra grade removal which alone would in most cases

be sufficient when replaced by a more porous coarse grained material which is not affected materially by water as are the very plastic soils such as many clays. With proper support from the sub-soil and a reasonably smooth surface to the pavement, a thickness of 6 ins. for the concrete foundation seems adequate especially as most heavy loads are now hauled on motor trucks having rubber tires. The trucking interests have found that it is not economical to carry loads in excess of about 750 lbs. per inch width of tires. This insures wide double and triple solid rubber tires on each rear wheel and a good distribution of the load over the pavement so that by the time it is spread through the thickness of the pavement and the concrete foundation the pressure intensity is usually well within the supporting value of the soil. Some states have limited the loads permitted on their highways, but here we have a limit placed by the effect on the truck owners' pocketbook, which is more easily enforced than the other.

Supporting Power of Foundations

When in exceptional cases it may be necessary to use a greater depth of concrete than 6 ins., it should be remembered that the supporting power of the concrete foundation varies about as the squares of the depths, as for example, 7-in. depth concrete would have about one and one-third the supporting power of 6-in. concrete, 8-in. concrete one and three-quarters, 9-in. concrete two and one-quarter and 10-in. concrete three times nearly the supporting power of 6-in. concrete. By keeping this in mind it should prevent wasting money in using too great an increase in depth in special cases.

Another matter that the tests have brought out is the fact that while the compressive strength of 1:3:6 was 50 per cent of that of the 1:1½:3 concrete, the difference between the beam and slab strength of these two mixtures did not exceed 20 per cent.

Damage by Water

In addition to damage from heavy loads the pavement, including its foundation, may be injured by water entering a clayey or other plastic sub-grade material from terraces or sidewalks and lifting and cracking the foundation and pavement by the swelling of the sub-soil. Sometimes this may be caused by frost heaving the foundation when there is a large amount of water in the plastic soil under the foundation. During the past season the writer was engaged upon an examination of some breaks in foundation and pavement where a study of the conditions shown by openings and the history of the breaks as to when they were noticed after the completion of the pavements and before freezing weather and the soil condition in the terraces on the uphill side and the clay of the sub-soil showed conclusively that the breaks were due to the soil conditions and not to any loads to which the pavement had been subjected. These are further reasons for improving the sub-soil rather than increasing the depth of the foundation, as a considerably heavier foundation would have probably been broken by the heaving of the clay when it becomes wet, and if not by this then later by the action of the water in the sub-soil freezing, and lifting the pavement. About 20 years ago the author had several streets paved with asphalt on concrete foundation in a suburban development, where there was a layer of clay directly under the foundation and back of the curbs there were wide grass plots. A severe winter followed a wet fall and caused this pavement to be lifted as much as 2 ins. in places as evidenced around sewer manhole heads. After the frost went out of the wet clay the pavement settled back, but unevenly and cracked badly in so doing. Since that experience he has been very chary about placing the foundation directly on clay or other plastic material if there was any chance that water might penetrate it, whether in a cold or in a warm climate, as water alone will cause it to swell and lift the foundation and frost will increase its volume still more.

Six-Inch Base Recommended

From our present knowledge we believe that a 6-in. depth of foundation is sufficient to carry modern traffic, provided the sub-soil is good, and if it is poor that it is better to improve the sub-soil rather than to use additional concrete in such cases.

The foregoing paper by Mr. Pollock was presented at the recent annual meeting of the American Society for Municipal Improvements.

IMPORTANCE OF ADEQUATE STREET DRAINAGE

By Harlan H. Edwards, C. E., Pasadena, Calif., Formerly City Engineer, Danville, Ill.

Adequate street drainage is of great importance in our cities and towns, for thousands of dollars are lost or wasted each year because of the lack of a way to get the rainwater off the streets quickly. Adequate drainage permits pavements to be constructed without ditches or gutters across them at every intersecting street. It permits travel on our earth streets much sooner in wet weather than could be otherwise done. It prevents the flooding of surrounding property by the backing up of water during heavy rains. It prevents the saturation and eventual destruction of pavements by standing water and, finally, when street slopes and sewers are properly located, the pavements are cleaned by the rains, thus saving many dollars that would be otherwise spent on shoveling and hauling away street dirt.

The absence of underground sewers or storm water drains is an absolute damage to any community. It brands the city as a "back number"—a place where public improvements are not appreciated, and as the home of unprogressive citizens. Surface drainage of all streets means the turning of some pavements into open sewers during rainy times. It means the ever-present danger of overflow in the lower portions of the unsewered district, while in any event, the receding waters always leave the street littered with debris of all kinds, which has been brought down by the waters from the streets and alleys above. Great inconvenience is caused pedestrians by this heavy surface flow of water, sometimes even making necessary the use of boots in travelling the lower portions of the city. In fact, large sections of pavement have been known to float away during excessive and prolonged rains. It is seen, therefore, that some means of quickly removing the storm water from the streets is a necessity in all progressive communities.

Adequate drainage, therefore, is best accomplished by a complete system of sewers, into which the rainwater can be directed from the streets at frequent intervals. Cast iron inlets placed at every street intersection and at intervals along the street in long blocks direct the water quickly into the sewers, and permit a better arrangement of street slopes or grades. The steeper these grades can be made, the faster the water will move along the gutter exerting a sort of scouring action upon the street and gutter, washing the dirt off through the sewers. Where pavements and sewers can thus be planned together, many dollars can be saved in future street cleaning. This saving alone, if properly taken into account, would go far toward paying back the original cost of the sewers..

SOME EXAMPLES AND RESULTS OF BAD STREET DRAINAGE
Left and Right: Old Style Extension of Gutters Across Pavement at Street Intersection. Center: Debris Left on Street Pavement by Storm Water

The elimination of cross gutters is another thing which the installation of sewers permits. In years past, when horse-drawn vehicles were the only ones using the streets, gutters extending across the street intersections were not considered objectionable. Now, however, swiftly moving vehicles find such gutters actually dangerous and a menace to travel. Some streets are really impassable to vehicles travelling faster than a walk on account of such gutters as are shown in the photograph. Things like these should be eliminated by the building of sewers, in the interests of public safety, if for no other reason.

They are dangerous to traffic, unsightly, and a public nuisance.

Some cities are blessed by the possession of good natural slopes to their streets, yet few have taken advantage of this as an aid to clean streets. Few people seem to realize that where properly used, money invested in sewers will return a handsome profit to the investor, in future savings. Since they are unseen, they are unthought of, yet when once installed, the first cost is the whole cost. They are permanent, they require very little attention or maintenance, yet they are always active in the service of the public.

EFFICIENT FIRE PROTECTION AND PREVENTION

By Frank C. Jordan, Secretary, Indianapolis Water Co., Indianapolis, Ind.

The curtailment of America's fire losses is one of our most serious problems and demands the attention of our ablest citizens. Shortly after the war, our fire losses began to climb with astounding rapidity toward the $500,000,000 mark. Last year they reached this point—reached it and kept on soaring until they registered a total of $521,860,000. This sum exceeds that of any other year even including 1906, the year of the San Francisco conflagration. No great conflagration marked the year 1922, our immense loss for that year being the result of thousands upon thousands of fires, some of them insignificant, but all contributing to a total of immense proportions. Inflated property values have played a part in raising the total; likewise the congestion of population in a comparatively small number of cities. But losses by fire have greatly outstripped the growth of population.

In 1912 the United States Census Bureau reported a total population of somewhat over 95,000,000, and the per capita fire loss was $2.16. Ten years later, the population had increased but 15 per cent, while the average per capita fire loss amounted to $4.75, an increase of more than 100 per cent.

The fire losses in Great Britain during the year 1922 totaled $30,812,000, as compared with our fire loss of $521,860,000. The population in Great Britain in that year was 45,000,000, as compared with our 111,000,000. Great Britain has been showing a reduction in its fire losses, and its per capita for 1922 was 72 cts., as compared with our per capita of $4.75.

Public Carelessness

A careful survey of the causes leading to our fire losses proves conclusively that the largest part of the humiliating fire record of 1922 was the product of public carelessness. If the fire losses in the United States continue at the rate established during the first nine months of 1923, our country will suffer a fire loss of more than $5,600,000 during the period of three days. The loss of life by fire will be approximately 146, and in addition thereto 170 citizens of our country will be so seriously injured by fire as to be made unfit for active duties, in this 3-day period. To the staggering waste of life, health and wealth, our state contributes a certain portion, and it is to the proposition of decreasing that portion that I would call attention.

The fire losses can be materailly decreased if we will build a thoroughly efficient public fire service and couple with that a systematic training in Fire Prevention.

Grading Cities

In grading cities with reference to their fire defenses and physical conditions, certain standards have been adopted and a plan has been worked out for grading the cities according to the deficiencies existing in the various departments. The sum of the maximum points of deficiency totals 5,000 and is divided in accordance with the relative values of the features as follows:

Water supply	1,700 points
Fire department	1,500 points
Fire alarm	550 points
Police	50 points
Building laws	200 points
Hazards	300 points
Structural conditions	700 points

That is, a city where the fire defenses and physical conditions are excellent, would have few points of deficiency and one where conditions are as bad as possible would approach 5,000 points. You will note from these figures that the water supply is given a weight of about one-third of the total requirements. An adequate water supply is considered as being of slightly more importance than an adequate fire department, as a water system is of some value for fire protection where there is no organized fire department but a fire department without water is almost helpless. You will

further note that the official city is charged with 2,300 points in this grading, namely, 1,500 for the fire department, 550 for the fire alarm system, 50 for adequate police supervision and 200 for building laws. The public is, generally speaking, charged with 1,000 points, 300 covering hazards and 700 covering structural conditions.

Water Supply

The water supply is judged from two viewpoints, adequacy and reliability, and a failure to measure up to both of these requirements will mean an inadequate public fire protection service. In grading a water system, deficiency charges are made under 32 separate headings. Time will not permit of a detailed statement covering all of these, but a reference to a few of them will be well worth while. The chief executive, either superintendent or chief engineer, shall be competent and qualify by experience. Employes shall not be subject to removal by every incoming political administration. Records and plans shall be such as to facilitate repairs and to permit of the efficient operation of the system. Emergency crews shall be quickly available; fire alarms shall sound in appropriate water works quarters. Sufficient water shall be available to furnish thoroughly adequate service, including the full required fire flow. The pumping stations and pumping units must be well designed and constructed and must be kept in good working conditions. The pumping capacity must be such as to provide for adequate reserve. The distribution system must be installed in accordance with best engineering practice, and the material used must be of such quality as to withstand the hard service to which it will be subjected. The system must be properly valved and there must be such a spacing of fire hydrants as will give a proper degree of public fire service.

Fire Department

The fire department is graded as follows:

Fire Department:

1. Equipment—Kind, amount and distribution of equipment, degree of serviceability and installation of standardized couplings.
2. Personnel—Paid or volunteer, number, fire methods used, morale.
3. Organization and Supervision—Inspections, reports, records, company organization.

Fire Alarm System:

1. Equipment—Type and extent of equipment, location (as regards disablement by fire), number of telephones.
2. Organization and Supervision—Operation of system, maintenance, personnel.

Other features, including private plant protection, outside emergency aid, willingness of the police department to cooperate, etc., are taken into account in the grading.

A large number of cities throughout the United States have been graded in accordance with these standards, and many cities are making an honest effort to strengthen the weak parts in their public fire protection service and bring their various departments to a high degree of efficiency. It is, however, very significant that the leading fire protection and fire prevention organizations deem it necessary to pass resolutions year after year calling our attention to the value of a careful study of these deficiency items and a compliance with those recommendations which would lead to a more efficient fire service. For many years past the annual conventions of the National Fire Protection Association have adopted resolutions advocating certain measures in their warfare against the needless sacrifice of human life and property by fire, and these resolutions were again adopted at the 1923 convention held in Chicago in May. These resolutions cover twelve important items of fire protection and prevention, but the time allotted for my paper will not admit of a careful study of every one of these. I would, however, direct your attention to five of these paragraphs.

Important Items in Fire Protection and Prevention

1. A careful study of the technical surveys of cities made by the engineers of the Committee on Fire Prevention of the National Board of Fire Underwriters, covering the items of water supplies, their adequacy and reliability, fire department efficiency, fire alarm systems and conflagration hazards, and of the possibility of co-operation among neighboring cities through mutual aid and the standardization of hose couplings. The organization of local fire prevention committees to promote these objects.

2. The systematic inspection of all buildings by city fire marshals or local firemen to insure the vigorous enforce-

ment of rules for cleanliness, good housekeeping, and the maintenance of safe and unobstructed exits, fire-fighting apparatus and other protective devices, and to enable firemen to become throughly familiar with the essential structural and other features of buildings which it is their duty to protect.

3. A more general legal recognition of the common law principle of personal liability for damage resulting from fires due to carelessness or neglect, and the enactment of laws or ordinances fixing the cost of preventable fires upon citizens disregarding fire prevention orders.

4. The education of children and the public generally in careful habits regarding the use of fire, and the general adoption by the schools of the United States of the fire prevention manual, "Safeguarding the Home Against Fire," prepared by the National Board of Fire Underwriters with the assistance of the United States Bureau of Education.

5. The adoption by municipalities of the standard building code of the National Board of Fire Underwriters, to the end that fire-resisting building construction may be encouraged, the use of inflammable roof coverings prohibited, adequate exit facilities from buildings assured, and interiors so designed and fire-stopped as to prevent or materially retard the development and spread of fire therein.

Practically the entire story of efficient fire protection and prevention is covered by these recommendations, namely, a careful survey of our fire fighting facilities, a systematic inspection of all buildings, the enactment of personal liability laws, the education of the public in regard to fire prevention measures, and the adoption of a standard building code.

Fire Prevention Program in Indianapolis

During the past three years, the city of Indianapolis has been engaged in a fire prevention program which has attracted nation-wide attention. The success of this program has been due to the fact that those in authority have given most careful thought to the important items referred to in these five paragraphs. The Indianapolis Water Company, with which organization I have the honor to be associated, has given most careful consideration to the question of adequate service for public fire protection. For years the company has pursued a liberal policy in reference to its water main extensions, adequacy of plant equipment and water supply, hydrant installations, etc., and for years it has been making a whole-hearted effort toward complying with all reasonable requirements relative to public fire service. The company has availed itself of the most competent engineering advice, and has followed this advice in carrying forward its program of construction. During the year 1923 our construction expenditures will total approximately $1,000,000, and a large portion of this expenditure is directed primarily toward furnishing a larger volume of water for fire service. I bespeak for every water plant of the state such a broad-gauged policy as will make possible the building of a plant which will be able at all times to furnish a thoroughly satisfactory water service both for public fire protection and domestic consumption.

The city of Indianapolis has purchased thoroughly modern fire equipment, and the responsible heads are making a concerted effort toward furnishing a high-grade public fire service.

Under the supervision of Fire Chief O'Brien and Mr. Jacob E. Riedel, chief of the division of fire prevention, a systematic inspection is being carried on in the city of Indianapolis, which in its degree of efficiency is second to none in the United States; 41 firemen are engaged in this work, and these firemen are not only rendering a valuable service in helping to prevent fires, but they are becoming thoroughly familiar with all of the properties in their neighborhood, thus adding to their efficiency.

Attention is directed to the thought that in future years our fire departments will devote more time and energy to the prevention of fires and less to putting them out once they have started. This will not be as spectacular as fire fighting, but it will be much more efficient.

The fire department has a well equipped drill school and training college, and this school is contributing largely to the efficient handling of the fire department equipment and to the curtailment of our fire losses. This work commends itself to the careful attention of every one interested in the subject of efficient fire protection. It is one of the most important features of the modern fire fighting organization, and has not received the consideration which its importance warrants.

The responsible authorities are making a concerted effort toward the elimination of the indiscriminate use of the public

fire hydrant, it being found that the use of the public fire hydrant by other than trained firemen leads to frozen or broken hydrants with a serious diminishing of the efficiency of the public fire service.

You may feel that your water plant superintendent is "cranky" when he enters a strong protest against the use of the public fire hydrant by street and building contractors, street cleaning and flushing gangs, etc., but the fact remains that such use leads to a serious decreasing of the efficiency of the public fire service and must be discouraged.

The Fire Prevention Committee of the city of Indianapolis has given considerable thought to the question of personal liability for damage resulting from fires due to carelessness or neglect. The committee has been responsible for a considerable amount of publicity in reference to the enactment of a personal liability law, and it is our hope that such a law will be enacted and enforced, with a resulting decrease in Indiana's fire losses.

Hundreds of thousands of pieces of fire prevention literature have been distributed through the Indianapolis schools; scores of city firemen in uniform have delivered fire prevention addresses before school children, luncheon clubs, etc.; excellent moving pictures showing various phases of fire prevention activities have been shown in all sections of the city, and through these, and other measures, the Fire Prevention Committee has attempted to make the public realize that a certain share of the responsibility for fire prevention rests upon their shoulders.

Our city has adopted a standard building code, and in addition thereto has passed an ordinance which is doing much toward eliminating one of our greatest fire hazards, namely, our wooden shingle roof. Other cities of the state are giving serious thought to the question of efficient fire protection and prevention, and it is a notable fact that Indiana was one of the very few states in the Union which showed a reduction in its fire losses during the year 1922.

The foregoing is from an address by Mr. Jordan before the recent annual convention of the Municipal League of Indiana.

CONFERENCE ON HIGHWAY BUILDING COSTS AND CONSTRUCTION PRACTICES

Factors in reduction of highway building costs and improvement of construction practices are to be developed when committees appointed by the Associated General Contractors of America and the American Association of Highway Officials meet for conference in New Orleans, December 3.

A strong element of public service is involved in the discussions to be held, as the creation of closer co-operation between highway engineers and contractors is logically to be expected to result in a maximum return for funds expended in highway construction.

The New Orleans meeting will have as its duty the translation of policies agreed upon by the two organizations during the past year into terms which may be directly applied to practice in the operations of state highway departments. Those who are leading the move for standard highway contracts and specifications see the conference between these two committees as an opportunity to gain the goal toward which such marked advance was made when the initial outlines of policy were adopted.

Commenting in this connection, Henry H. Wilson, member of the Advisory Board of the Associated General Contractors, and also a member of the committee which will represent the contractors at the New Orleans meeting, recently expressed himself and the views of his associates as follows:

"Many highway constructors who have long labored for the upbuilding of their industry, both ethically and economically, and who were convinced that real progress could only be achieved through the establishment of a degree of concord and action between public officials, engineers and constructors, whose benefits to the taxpayer would be unquestionably demonstrable, hailed the adoption of those policies last year as the harbinger of a new and better day in road building.

"Let us hope that there may proceed from the coming conference at New Orleans a vigorous and dynamic stimulus to every public official, engineer and constructor in the country to pool their purposes and make the policies already adopted (or to be adopted hereafter) accomplished facts everywhere. The old Roman fable of the body and its mem-

bers is peculiarly applicable to the relations of public officials, engineers, constructors, taxpayers and all others interested in highway building. If the coming conclave of the committees does nothing more than accomplish a real working union of the members of this fabled 'body' which will enable it to find its 'feet,' the meeting will be epochal. If this result is achieved it can be said in future years (somewhat in the words of the great Webster) that the meeting smote the rock of co-operation everywhere and abundant streams of benefit to all gushed forth."

THE PROBLEM OF HIGHWAY FINANCING IN AMERICA

By A. R. Hirst, State Highway Engineer, Capitol Annex, Madison, Wis.

The American people are living through the greatest transportation miracle of all time without in the least realizing that the miracle is taking place; without computing the cost of it, and without computing the cost of supplementing it by another miracle just as astounding in its scope and magnitude. Not one in ten thousand has the slightest realization of the economic, social and engineering problems presented by these twin marvel episodes—the development of the motor vehicle and of a highway system to meet the needs of it.

America passed through its first episode of highway building from 1800 to 1830; through its great era of canal building from 1810 to 1840; its great era of railroad building from 1850 to 1880. Its second great era of highway building commenced with faltering steps about 1890, attained some proportions about 1910, is now almost in full progress, with the probability that the major portion of the episode of constructing a modern highway system will take place between 1920 and 1940.

The Growth of Motorization and in Highway Expense

The figures indicating the development of motor vehicles and of motor transport and the parallel development of highway construction and maintenance are so astounding that they have passed almost unnoticed. Even the statistics showing the progress of the motorization and of the highway enterprise have hardly been kept. When one seeks to recover the facts of only a decade or two ago, he finds great difficulty in placing his hands on figures which are dependable. There are, however, available some figures which sketch the steps of the development of the motor vehicle and of highway expenditures in the last two decades with sufficient detail and accuracy for our present purposes. The four years used were selected because the United States Bureau of Public Roads had quite carefully collected the figures of national highway expenditures for three of them, viz: 1904, 1914 and 1919. Further, 1904 marks about the end of the period before the modern motor vehicle and highways era; 1914 the first beginnings of a real American highway construction program; 1919 the resumption after the pause due to the war, and 1923 the well started modern highway program.

In 1904 there were in operation in America about 58,000 automobiles. There were practically no motor trucks. In 1914 there were registered 1,711,339 automobiles and motor trucks. In 1919 there were registered 7,530,105 automobiles and motor trucks. In 1923, preliminary figures indicate a total registration of at least 14,000,000 automobiles and motor trucks.

In 1923 the people of at least 40 American states own and operate more motor vehicles than there were in all of America in 1904. In 1923, in New York and California combined, or in Ohio and Pennsylvania combined, there are owned and operated more motor vehicles than there were in all of America in 1914.

In 1904 the rural highway expenditures of America are reliably computed to have been $59,527,000; in 1914, $240,264,000; in 1919, $389,456,000, and in 1923 they are estimated to be at least $800,000,000. Roughly, the rural highway expenditures per motor vehicles in operation in 1904 were about $1,026; in 1914, $140; in 1919, $52, and in 1923, $57. The expenditures per motor vehicle in 1923 were 5 per cent of those of 1904; 40 per cent of those of 1914, and 110 per cent of those of 1919.

Fourteen million motor vehicles in 1923! The investment of the American people represented in them is probably ten billion dollars. The annual cost of owning and operating them was undoubtedly $5,600,000,000. This is nearly two billion dollars more than all taxes, exclusive of federal taxes, and over one-half of all taxes, including the federal taxes! They were operated a total of at least fifty-six billion miles. These last two figures, it will be noted, give 10 cts.

per mile as the average cost of operation, which is conservative.

If we could, through the development of a real system of highways, reduce the operation cost of motor vehicles 1 ct. per mile (as we can), the annual saving to motorists would be $560,000,000. This capitalized at 4½ per cent would represent an investment of about $12,500,000,000. This could be proven to be a profitable outlay on this one item of saving alone.

One filling of their fuel tanks, even at present prices, costs the proud owners about $27,000,000. If each should lose a casing and tube, the cost of replacement, at a weighted average of $20 each, would be $280,000,000.

The above paragraphs are written with the idea of showing the large figures which must be dealth with when we touch anything which relates to motor vehicles. This immensity must always be borne in mind when considering the problem of developing highways for motor transport.

We are not going to speculate very much on what may be the further development in the use and operation of motor vehicles. When the percentages of increase in the number of motor vehicles made and sold in the last two years are considered, it is quite sure that the end of motor vehicles increase is not yet near. At the end of 1916 there were 3,513,000 motor vehicles registered in America. At the end of 1923, 14,000,000. The numerical increase for the six years, 1917 to 1923, inclusive, was 10,487,000. It seems well within the bounds of probability that there will be a numerical increase of 6,000,000 in the six calendar years, 1924 to 1930, inclusive, so that by the end of 1930 there should be owned and operated at least 20,000,000 motor vehicles. This naturally makes the problem of providing highway service for them loom even larger than the present registration figures indicate.

Even with the meager figures available, a paper of much more length than has been assigned this one could be prepared bringing out the twin wonders of motor transport and of highway development, but we must leave these interesting speculations to other times.

The Financial Problem

It must be quite obvious from the above summary of the momentous developments in highway transportation in the last two decades that there has been precipitated upon the American people a problem in public financing unparalleled in the history of the nation. Financing the public schools, colleges and universities involves practically as much public money as highway work does. But the public schools have been a process of slow development, speeded up, it is true, by modern demands during the last two decades, but still a slowly developing growth of and from the basic American idea of free public education. The machinery of school administration is the growth of over a century. That the public schools must be supported by the whole people largely in proportion to their wealth is established.

The problem of highway financing has been forced upon us almost over night due to the unparalleled demands for transportation service and for highways. Taxation for highways in America for 1904 was practically a negligible factor in the total taxation. In 1923 it has reached such proportions that in many states it is nearly one-half the total tax bill of all units of government. Obviously, such an unexpected and unwelcomed increase in the obligations of government must demand especial consideration and special treatment.

It is not as if the other obligations of government were being reduced. It is not as if other public or private expenditures of the American people were being reduced. The cost of our government service to water-borne transportation is not decreasing; the cost of our railroad service is not decreasing. "On the contrary," as the polite Frenchman replied when asked on a rough morning on shipboard whether he had breakfasted. In addition to all of these former costs of transportation, we are in the midst of a most wild and exotic growth in the amount expended for personal transportation and in road service to take care of this increase in personal transportation.

We have stated that the cost to the American people of owning, operating and depreciating motor vehicles in 1923 was at least $5,600,000,000. This is in addition to the cost of constructing and maintaining highways and bridges in all units of government, which must have been $1,000,000,000. There are offsets to this new bill in that there are more people to be served with transportation, probably less expenditure for transpor-

tation by horse-drawn vehicles, and a greater volume of goods to be transported. But, it is an increase of at least $6,000,000,000 in our annual bill for highway transportation—largely for added highway transportation for persons—over the bill of 1904.

Whether the American people can afford each year to expend six billion dollars more for highway transportation than they did in 1904, we will not discuss. We will discuss the rural highway bill of America for 1923 as compared to the rural highway bill of 1904. The bill of 1904 was $59,500,000, and of 1923 is $800,000,000. The difference is $740,500,000. In general, the only difference between the highway conditions of 1904 and of 1923 is that in 1904 there were practically no motor vehicles, and in 1923 there are fourteen million of them. The change in the situation has been brought about almost wholly by the astounding increase in the transportation of persons and goods by motor vehicles. The increase in the cost to government, due to the American people's possession of motor vehicles has, therefore, been for rural highways alone (disregarding the very largely increased costs imposed upon the cities and villages) approximately $740,500,000.

In 1904 the motor vehicle paid toward the cost of highway work in America practically nothing. In 1923 the taxation upon motor vehicles other than the government luxury tax, which has no bearing up the financing of highway work, is probably $300,000,000. Of this, probably $100,000,000 is paid as a personal property tax not dedicated for use on highways, while $200,000,000 is probably paid in license fees, franchise taxes, gas taxes, etc., the proceeds of which go largely to highway uses. In other words, as an especial class of property signally benefiting from highway development, the motor vehicle is taxed for the construction and maintenance of highways in 1923 approximately $200,000,000. (This is 3.6 per cent of the total cost of owning and operating them in 1923.) Disregarding as negligible the taxation on motor vehicles for highways in 1904, it is $200,000,000 more than they paid in 1904. The increase in the rural highway bill between 1904 and 1923 is above shown to be $740,500,000. Therefore, the motor vehicle is charged in taxes, paid due to its use of highways and not due to its existence as a luxury or to its existence as a piece of personal property, about 27 per cent of the additional cost of constructing and maintaining rural highways imposed upon government by its ownership and use. Please, again, remember that the added costs (and they are great) imposed upon cities and villages by motor vehicle ownership are not included in the above figures.

Who Shall Pay the Highway Bill?

Of course, those who believe that the motor vehicle is already overtaxed will contend that other causes have led to the increase in the highway programs, but this other urge has been so small as to be negligible. In a broad summary, such as this, we are certainly justified in saying that the increase in the American highway program of today over that of 20 years ago is caused by the ownership and use of motor vehicles. We know that every plan for highway construction or maintenance; every relocation; every bridge design; every plan for highway systems and layouts; in short, every highway problem of nation, state, city and county originates with and has its conclusion drawn from a study of the present and future demands of motor vehicle traffic.

In national, state, county or city legislative bodies or highway organizations there is no discussion of roads, streets or bridges which does not hinge on the necessities of the motor vehicle. The horse and the horse-drawn vehicle have practically disappeared from consideration, and in not one phase of modern highway development does the presence or the absence of the horse have any real bearing. In ninety-nine cases out of a hundred, horse-drawn traffic is given as little consideration as is the number of dinosauria and mammoths who may traverse the highway. We are a motorized people, dealing with a problem of motorized transport and commencing to pay the bill for motorization.

It is also urged by the opponents of further imposts upon motor vehicles that other property and other persons are also benefited by the development and maintenance of highways, and should pay their part of the cost. We would be the last one to deny that every person, every business, every piece of real property, every social and business activity does benefit and benefit greatly from the development of highway systems. We would be the first one to say that they should pay and pay to assist in the development of highways. But other property and incomes have all other governmental activities to support, and they cannot be bank-

rupted for highways. They must help to pay, but after they have paid for highways all that can, with any equity, be imposed upon them, there remains a large bill which cannot be paid by property or by incomes, but which must be paid by the motor vehicle. There will be paying enough to go around, so that none will feel slighted.

The motor vehicle propagandist then avers that the amount of the bill to be paid by the motor vehicle should be the cost of maintaining highways, and that the motor vehicle should pay no part of the cost of the construction enterprise. How this remarkable conclusion was first arrived at we are unable to determine. Certainly it should be included and enshrined among the most laughable jokes ever sought to be seriously presented to the attention of the American public. "Life" never printed anything half as funny. If carried to its logical conclusion, this masterpiece of economic thought means, of course, that the poorer the roads of a state, the more the vehicle owners of that state should pay; the better the roads, the less they should pay.

Under this wonderful theory, for instance, a state having a 10,000-mile road system to construct might determine to construct it of cement at an average cost of $40,000 per mile. The total cost would be $400,000,000. "This, property should pay." The cost of maintaining this system, when fully built, would be about $3,000,000 per annum. "This the motorist should pay." On the other hand, the state might determine to build the system of gravel and other inferior surfacings at an average cost of $10,000 per mile. The cost of the system would then be $100,000,000. "This property should pay." The cost of maintenance would be about $10,000,000 per annum. "This the motorist should pay." The motorist should pay seven million dollars more per annum for a road system of inferior value and economy than he should pay for a system of roads conceded to give better and more economical service to motor transportation every day in the year. Is it not astounding that men, usually quite sane, seriously claim that this is common sense and correct economics?

Proportions to Motorists and to Other Property.

Is there any measure of the proportion that motorists should pay of the cost of the highway program of a state? No measure has so far been established. The problem has come upon us so suddenly, so much of the reasoning upon it has been wild and unfounded, that American thought has not even begun to crystallize upon any basic measurement of what the motor vehicle should pay.

We have had, of course, the scale of fees in the "proposed uniform vehicle license law" urged as a panacea by the National Automobile Chamber of Commerce. This was proposed several years ago as fair taxation, but died before it was hardly born. As far as we know, no American state ever adopted it and we venture to predict that no American state ever will. Its scale of fees is unscientific, unfair, and far too low; and has value merely as a matter of history.

We claim that there is only one measure of what the motor vehicle owners should pay, viz:

(1) The total sum paid for highway service by the motor vehicle owners of a state should be measured by the benefits the motor vehicle owners of the state receive from the state's program of highway construction and maintenance.

This should be quite obvious. A tax collected should represent services rendered or to be rendered and benefits received or to be received. If great services and benefits are given the owners of motor vehicles in a given state, the charge which that state should make on them can legitimately be much higher than the charges which should be made by a state which gives few benefits and offers little facilities for travel.

If the reader will compare states with the roads of which he is familiar, it is believed that he will assent to the proposition that taxation upon motor vehicles should not be uniform, with all motor vehicles of like kind paying the same tax in every state. He will agree that proper and fair imposts upon motor vehicles will vary with the states, and that the motor vehicle owners of different states should pay and should be willing to pay different sums varying with the highway facilities offered them by their state and county governments. Does the "proposed uniform vehicle license law" meet these conditions? Naturally, it does not.

A Proposed Guide to Judgment.

We are going to venture to give what we believe is a formula by which there can be determined the sum which the motor vehicle owners of a state should annually pay toward its highway program, in payment for benefits they receive from the program. By the highway program of a state, we mean not only the program of the state itself, but also of all units of

government in the state, including its cities.

"The Hirst Formula." The motor vehicle owners of each state should each year pay for their highway service one half of the total amount made available in that year to pay the cost of the state's highway program, after deducting from said amount the total amount made available to pay the cost of the state's highway program in 1904.

Ninteen hundred and four is selected as the basing year because quite dependable figures of highway expenditures in all states are available for that year, and because it quite accurately marks the real beginning of the motor era.

Please again read the formula before condemning it, and note especially that its terms do not include the expenditures made in any year from the proceeds of bond issues, but only the portion of the cost of bonding paid in that year.

Applying this formula to a hypothetical case: In a certain state there was made available in 1904 to pay the cost of all highway work, $10,000,000. There is to be made available $40,000,000 in 1925. The amount the motor vehicle owners should pay in 1925 is one-half the difference, or fifteen million dollars.

The formula means that there would be paid by property and from other sources of governmental incomes:

(a) The total cost of highways which they paid at the end of the era of horse-drawn transportation.

(b) One-half of the additional highway cost imposed upon government by the ownership and use of motor vehicles.

It, of course, means that the owners of motor vehicles would pay:

(a) One-half of the additional highway cost imposed upon government by his ownership of motor vehicles.

This does not seem to us to be unfair to the motorist. If there is any unfairness about it, property other than motor vehicles is probably paying, to say the least, a good full price for the general benefits and advantages incident to highway improvement. Translated into national figures the formula means that, based on total highway expenditures of $200,000,000 in 1914 and of $1,000,000,000 in 1923, the motorist should have paid $400,000,000 in 1923 for use on highways. (Not including the luxury tax and the personal property tax, neither of which is a tax for highways.) This compares with the actual payment of $200,000,000, and means that they should have paid $200,000,000 more than they did pay in 1923, or approximately $14 more per motor vehicle, on the average.

We expect that many will oppose any proposed application of the formula to specific tax problems. We do not claim that it is perfect. In meeting especial conditions in certain states its arithmetical result would have to be modified by the application of common sense. We do claim, however, that it is of value as a guide to judgment. We do claim that it is the first mathematical formula proposed that recognizes the existence of the fundamental facts which should largely determine the relative part of the cost of highway programs to be paid by motor vehicle owners as such, and by other taxpayers as such.

Apropos to opposition to new ideas as to taxation,, Macaulay in his great History of England, in discussing the new highway taxation imposed there in 1685, characterized the public attitude on the new taxes in language just as good and true now as it was when Macaulay wrote it in 1846. We quote him:

"A change was at length effected, but not without much difficulty. For unjust and absurd taxation to which men are accustomed is often borne far more willingly than the most reasonable impost which is new."

Present Systems of Taxation.

We will now briefly summarize and comment upon the various forms of taxation upon motor vehicles.

Valuation Taxes—We believe that there should be a valuation tax upon motor vehicles if there is to be a valuation tax upon any class of property. Of course, if the theory of collecting taxes upon the basis of the valuation of property is wrong, then a valuation tax upon motor vehicles is wrong. Vice versa, if the valuation theory generally held is right, then the collection of a tax based upon the relative valuation of motor vehicles is right.

The more expensive automobiles are owned for the same reason that the more expensive homes are owned; that is, because the owner believes that they repay him for the added investment and the added running expense in style, comfort, economy and convenience, or in the ability of himself and his family to enjoy life. If he really believes these things are true, he should be willing to pay additional personal property taxation, just as he is willing to pay an additional price to own and operate the more expensive house or motor vehicle. It should be recognized, however, that a valuation tax on

motor vehicles is not a highway tax, but a property tax.

Horse Power Taxes—Many states license motor vehicles upon the basis of horse power. We can think of no physical attribute of a motor vehicle which bears so little relation to the destructiveness of it as does its horse power. Horse power bears little or no relation to the speed, the weight, the value or the use of a motor vehicle. There are at least 32 passenger car models on the American market which have the same or less horse power than the Ford. These 32 models weigh from 1,600 lbs. to 3,500 lbs. and retail at from $500 to $2,500.

Licensing by Weight—This system somewhat classifies the relative destructiveness of various cars as between themselves, and of motor trucks as between themselves and as distinguished from automobiles. Weight has also some relation to value, but only when the vehicles are new. If there is to be a graduated classification of cars for the purpose of licensing them, their weight is the best factor. We believe there should be such a classification.

"Police Power" Licensing—This is a necessity. The cost of the license plates, licensing and of proper motor vehicle policing should be included in the weight license fee and collected at the same time.

Franchise Taxes—Wheel Taxes, etc.—Some states still permit units of government smaller than the state to make charges upon motor vehicles in addition to taxing them as personal property. We believe that such charges should not be allowed to be made but that the full charge for the use of highways should be imposed and collected by the state. Outside of the debatable federal luxury tax now in effect, we believe that the Federal Government should not tax motor vehicles. If everyone around the farm milks the farmer's cows whenever they feel like it and use the milk for all kinds of purposes, the farmer's monthly milk check will be much reduced. Besides, the herd would develop an extremely nervous and irritable disposition.

The amount which the motor vehicle owners should pay for highway service is a thing individual to each state. It should be determined upon by the legislature of the state as a result of the most mature deliberation. Simultaneous increases made by several units of government might, if permitted by law, seriously embarrass the motor vehicle owners and the motor vehicle industry.

The states are the best and should be the only collectors of imposts for highway service made upon motorists. If the division of responsibility for the main highways is such as to make it advisable, there should be distributed to the counties a part of the proceeds. The state and county highway programs in every state should and will consume all that the motorist should fairly pay toward the highway program. The lesser units of government, such as townships, cities, and villages, should be content to see the state and county taxes on property for highways reduced by larger collections from motor vehicles. This will enable them to increase their charges upon property for strictly local purposes, including local highways.

The sum which can fairly be collected from motor vehicle owners has a maximum. If the Federal Government takes a share and the local municipalities take a share, the state and county share will be so much the less. Necessarily the state and counties must make up the deficit by imposing direct taxes upon property or by taking a larger share of income taxation. This simply complicates the situation without changing the final result as to the total taxes paid by the various classes of property.

Motor Fuel Taxes—The motor fuel tax, commonly known as the gas tax, in our opinion, is by far the most scientific impost upon motor vehicles. It meters highway service and the benefits received from the use of highways. It approximates toll gate results without the infirmities of toll gate procedure. The consumption of gasoline varies with the weight, the speed, and the mileage of the motor vehicle. No other factor in the car's domestic economy reflects so closely the benefits received from highway use.

It has been suggested that a tire tax would be just as good as a fuel tax. This might be true if it were not so easy to mail or ship tires, but we fear that if a tire tax were in effect the business of every tire dealer would be with the people of other states. This would be unnecessarily expensive and cumbersome and yield no tax revenue to anyone. On the other hand, gasoline is bought usually from day to day, is best bought in that way, and can thus be handled more cheaply and more safely than if shipped and stored for individual use.

Objection is made that the worse the road, the more fuel consumed, and the more tax paid. This objection can not be met by any argument which we can devise except that as highway construction proceeds, the mileage of road that this objection applies to will become less and less. It is the only practical objection ever urged against the fuel tax, and objections equally valid can be urged against any tax ever in effect or ever proposed.

States can adjust *ad infinitum* license fees fixed by the horsepower, weight or valuation of motor vehicles, or by any combination of these factors. They can probably attain some fairness in the relative fees to be paid by the different kinds of cars and trucks. It can be determined that a Ford should pay so much, a Cadillac so much, a 5-ton truck so much. The relation thus established between them may be fair. But how about the relation between the Ford which travels 2,000 miles and the Ford which travels 15,000 miles—the Cadillac which travels 5,000 miles and the Cadillac which travels 40,000 miles—the 5-ton truck which travels 5,000 miles, and the one which travels 25,000 miles?

If the relative use of highways by various motor vehicles is to be included as a factor in determining the highway tax to be paid by the motorist, then the motor fuel tax must be in effect as one factor in the total imposts. It is the only practical-to-collect impost which marks relative highway use and the relative benefits therefrom.

We believe that many states will find it necessary, at least during the coming heavy construction period, to impose fuel taxes of about 5 cts. per gallon. States which have been extremely backward in highway development, may have to collect as high as 10 cts. per gallon. We believe it will be usual to exempt fuel used other than in highway transport from paying the tax. This will cause some abuses, but there are abuses in every tax system. As soon as motor fuel taxes of quite uniform amount are in effect in every state, practically every objection to the gas tax will have been eliminated, and a method of highway taxation and of highway financing, will have become universal which is as nearly in accord with the equities in the case as human ingenuity can devise.

It is impossible in the compass of a thirty minute discussion of highway financing more than to briefly touch some of the high spots. We have tried briefly to paint a picture of the situation, with no greater hope than that we might start further and much more effective discussion of this major problem of the American people.

It seems absolutely certain that the American people must spend in the next 20 years in the development and maintenance of their highway systems, both rural and urban, a sum approximating twenty billions of dollars. This must inevitably be true, unless the American people not only do not increase, but on the contrary, greatly reduce their present use of highways for transportation. It is equally true that we are facing a financial enterprise and an engineering enterprise far surpassing any previous public enterprise except that involved in the prosecution of the late war.

These things being true, it must be quite obvious that, inasmuch as there appears to be no prospect of a reduction in the standard of American living or in the public expenditures for education, parks, water supply or public health, we must look to and develop new sources of revenue for the payment of a considerable share of the cost of this new highway enterprise. It appears to us that this source of very materially increased public revenue must be the motor vehicle, the thing which largely sets our scale of highway expenditure, the thing which benefits most from the expenditure.

If we are to get very far with this line of thought, we must divorce from our minds the idea that imposts upon motor vehicles for use in building and maintaining highways, are, properly speaking, taxes. They are not taxes. They are just the remainder of the bill due to our ownership of motor vehicles.

One buys a motor vehicle. He pays the price and owns the vehicle. If one is to get any use of it, he must buy fuel to propel it, oil to lubricate it, he must replace worn and broken parts and the tires as they become useless. The costs of these are a legitimate part of the cost of owning and operating a car. We do not consider it robbery when a tire man charges us $20 for a casing, or a gas man $2 for a filling of gas. We regard the owner of the tire shop and of the filling station simply as merchants selling us a commodity which we must have in order to operate our car, so that it may return us dividends, either in money or pleasure, or both.

In exactly the same way we must buy our highway service from the state. Highway service is just as essential and is just as much a part of the legitimate cost of operating a motor vehicle as is anything else that must be bought if we are to operate it with economy and efficiency. A fair charge by the state for this service is not robbery, murder or arson. It is just as clean cut and defensible a business deal as is any other business deal connected with the purchase and operation of a motor vehicle. We pay a fair charge made by government for a commodity—highway service—which, as motor vehicle owners, we must have. Probably we will get out of our payments to the state a greater return than we get out of any so-called private business deal incident to our ownership of a motor vehicle.

We must brush our brains clear of cobwebs, obsessions, prejudices and bunkum, and calmly recognize that when we bought and insisted upon operating fourteen million or more motor vehicles, we bought also a highway expenditure of billions of dollars, just as much a part of the cost of these motor vehicles as are themselves, their tires, their engines, and their supplies. They go together, the motor vehicle and the highway on which it must run. All the costs must be paid.

When the American people come to this only sane viewpoint, it will be possible rapidly to develop the required highway systems. If the motor vehicle is to be soon fully served, if it is to become in our time an instrument of transportation operating, in fact, with something like 100 per cent efficiency 365 days in the year, we must invest billions in highways, and the owners of motor vehicles must pay a fair share of the bill.

In our own state, and elsewhere, we have been sometimes indicted as an enemy to the motor vehicle industry and to the motorist, because we have insisted that the motorist must pay adequately if he wished economictl highway service. Whether or not we are or have been an enemy to the motorist we are unable to prove. We have spent 20 years in this road game but neither our enemies nor our friends can now fairly judge us. Results and highway history will do that in due time.

We do still insist that the motorist must pay—adequately, largely—almost until it hurts. Building a modern American highway system, comprising at least 500,000 miles of road, in two or three decades is not child's play. It is an enterprise of appalling magnitude. It can be done, it will be done, because when the American people need or even wish for anything, they get it. They not only wish for highways, they need them, and they will get them. But they must pay the price—and the principal user of the road, the motorist, can not escape almost scot free from the paying!

The foregoing paper was presented by Mr. Hirst at the recent annual meeting of the Michigan State Good Roads Association.

UNIVERSITY OF MICHIGAN PROVIDES 20,000 SQ. FT. FOR HIGHWAY ENGINEERING AND TRANSPORT IN NEW ENGINEERING BUILDING

By Arthur H. Blanchard, Professor of Highway Engineering and Highway Transport, University of Michigan, Ann Arbor, Michigan

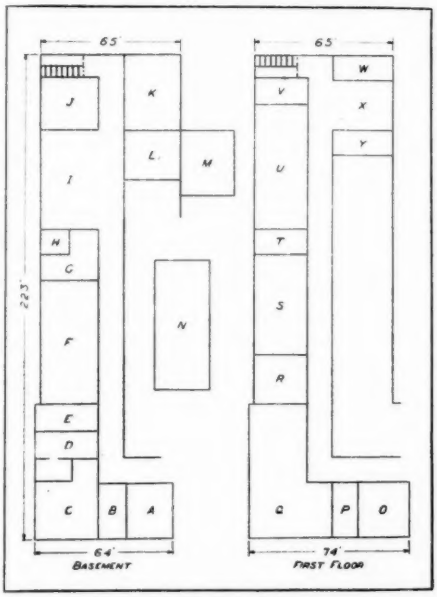
The University of Michigan, in 1919-1920, offered the first course in highway transport to be given in an American educational institution. The number of courses in highway transport now numbers eleven. The rapid development in educational work in highway engineering and highway transport is indicated by six courses in highway engineering being offered in 1918-1919, and 25 courses in highway engineering and highway transport being given in 1923-1924.

The Board of Regents has made provision for the personnel of the new division by establishing a chair of highway engineering and highway transport, and the appointment of an associate professor, an assistant professor, a librarian of the Davis Library of Highway Engineering and Highway Transport, an instructor and three assistants in highway engineering.

All State Highway Testing Done at University

At the time of the organization of the division an ideal arrangement was made with the Michigan State Highway Department, under which all the testing of highway materials for the department would be made in the University laboratory. This cooperative relationship has been efficiently developed in the interests of both the state and the University. The activities of the laboratory embrace un-

dergraduate and graduate courses in highway materials, research work by members of the staff, fellows in highway engineering and candidates for the master's degree; routine examination of materials and the collection of data relative to highway materials, especially deposits of sand, gravel and rock. During the year ending June 30, 1920, the routine work included the testing of 3,641 specimens, while in the year ending June 30, 1923, the number of specimens tested increased to 6,831. The materials tested included Portland cement, sand, gravel and stone aggregates, concrete, ledge rock, paving brick, corrugated metal pipe, clay tile and pipe, reinforcing steel, calcium chloride, tar, asphalt, oils, emulsions, bituminous mixtures and paint.



PLANS OF THE BASEMENT AND FIRST FLOOR OF THE EAST ENGINEERING BUILDING ASSIGNED TO THE DIVISION OF HIGHWAY ENGINEERING AND HIGHWAY TRANSPORT, UNIVERSITY OF MICHIGAN.

KEY TO BASEMENT FLOOR ROOMS.

HIGHWAY LABORATORIES: A. Sample Storage Room. B. Damp Room for Cement and Concrete Specimens. C. Equipment Room. D. Locker, Wash and Shower Room. E. Balance Room. F. Laboratory for Testing Asphalt Cements, Tars, Oils and Bituminous Mixtures. G. Laboratory for Testing Paints and Metals. H. Computing Room. I. Laboratory for Testing Sand, Gravel and Stone Aggregates. J. Cement Testing Laboratory. K. Rock and Brick Testing Laboratory. L. Receiving Room. M. Highway Material Bins, Elevator and Delivery Chute. N. Concrete Testing Laboratory (Located under main entrance lobby.)

KEY TO FIRST FLOOR ROOMS. O. Office of Professor of Highway Engineering and Highway Transport and Seminar Room. P. Stenographer's Office. Q. Davis Library of Highway Engineering and Highway Transport. R. and S. Lecture Rooms for Graduate Courses. T. Office of Assistant Professor of Highway Engineering and Highway Transport. U. Highway Engineering Drafting Room. V. to Y., inclusive. Offices of Associate Professor of Highway Engineering and Staff of Michigan State Highway Laboratory.

Fellowships

Through the generosity of Mr. Roy D. Chapin and the Detroit Edison Company, one fellowship in highway transport and three fellowships in highway engineering have been available each year since 1919-1920. Each fellowship pays the sum of $250 with an allowance of $50 for expenses. Many high grade reports covering important research problems have been prepared by the fellows. The annual competition for these fellowships has been keen, there being 63 contestants in 1922-1923. Graduates of high standing of many institutions have been attracted by these fellowships, the fellows appointed having been graduates of Carnegie Institute of Technology, Colorado State Agricultural College, Cornell University, Dartmouth College, Iowa State College, Kansas State College, McGill University, Michigan Agricultural College, University of Colorado, University of Maine, University of Michigan, University of Missouri, University of West Virginia and West Point. A wide range of professional activities is represented by the men appointed. The 1922-1923 fellows occupy the following positions: Major, Quartermaster Corps, U. S. Army; Resident Engineer, U. S. Bureau of Public Roads; Assistant County Engineer, Texas; instructor in highway engineering, University of West Virginia.

Graduate Short Period Courses

It has been found that graduate semester courses only meet the needs of a small percentage of practicing highway engineers and men engaged in highway transport who desire to obtain advanced instruction, as such courses are not given during periods when it is practicable to secure a leave of absence. Recognizing this condition, the University, in 1919-1920, offered graduate short period courses in highway engineering and highway transport, leading to the degree of Master of Science or Master of Science in Engineering, arranged especially for men engaged in the practice of highway engineering and highway transport. These courses are given in periods of

two weeks each during the months from December to March, inclusive. Each course consists of 30 lectures, or the equivalent thereof, and counts as two hours' credit toward the total of 24 hours required for the Master's degree. Persons of mature age, who do not hold collegiate or technical degrees, but who give evidence of fulfilling the prerequisites of a given course, may register as special students, not candidates for a degree. In the first year, 1919-1920, when such courses were offered at the University of Michigan, the attendance was 29; while in 1922-1923, 110 men attended these courses, the average age of the men being 27 years, ranging from 23 to 56 years. These men came from the U. S. Bureau of Public Roads, state, county and municipal highway departments, contractors' organizations, companies manufacturing motor trucks, highway machinery and materials, universities, and from the field of highway transport. During 1923-1924 18 graduate short period courses will be offered, 10 in the field of highway engineering and 8 in highway transport. These courses will be given by a staff of 8 professors and 10 nonresident lecturers.

Library

Efficient graduate instruction requires exceptional library facilities for research work and collateral reading. The University is fortunate in being the present custodian of the Davis Library of Highway Engineering and Highway Transport, which is the most complete collection of literature on these subjects in existence. In addition to books, reports, specifications, monographs and files of trade publications, all technical periodicals which contain articles relative to highway engineering and highway transport are on file, hence the latest literature on the science and art of these subjects is available. The library is equipped with eleven comprehensive indexes covering its books, reports, specifications, pamphlets, catalogs of materials and machinery, and literature on highway engineering and highway transport.

The development of the activities of the division, the rapid increase in the enrollment of graduate and special mature students, and the expansion of the work of the highway laboratory, influenced the Board of Regents to allot 20,000 sq. ft. of working space for the offices, library, drafting room, graduate lecture rooms, and laboratories of the division of highway engineering and highway transport in the new East Engineering Building, which was opened for use at the beginning of the present collegiate year. The following keys to the plans describe the uses to which the 25 rooms in the basement and on the first floor of the north wing have been assigned.

MODERN CONSTRUCTION OF BRICK PAVEMENTS

By Will P. Blair, Vice-President, National Paving Brick Manufacturers' Association, Engineers' Bldg., Cleveland, Ohio

(Editor's Note: The following paper was presented by Mr. Blair at the annual convention of the American Society for Municipal Improvements at Atlanta, Ga., Nov. 12-16, 1923.)

At the meeting of this society at New Orleans, La., in 1919, we stressed the lack of information as to the conditions upon which we place the wearing surfaces of our streets and roads. We little realized then that our suggestions would be taken as seriously as they subsequently were. Results did follow by the appointment of a committee by the Federal Highway Council, for research of natural influences involved in the subgrade and its relation to road surfacing and traffic.

One of the principal discoveries influenced by the activities of this committee, disclosed the fact that subgrades of most soils throughout the country were subject to contraction and expansion, due to the influence of water. That the forces of expansion in the case of a saturated subgrade was one of extraordinary power, often resulting from its expanding power in the destruction of rigid surfaces, such as cement-filled brick roads, which hitherto had met with the approval of the industry.

As soon as this fact was established, together with information ascertained as to other agencies of destruction, it became perfectly apparent that the construction of brick wearing surfaces would have to be changed, in order to meet with less effect the destructive agencies discovered.

In the meantime the manufacturers of vitrified brick, through their local organization known as the Western Paving Brick Manufacturers' Association, had discovered and utilized a certain refined asphalt, which had the quality of maintaining its place in the brick joints under extreme high temperature, and did not become rigid and fragile under the in-

fluences of low temperature. Experience with this filler, covering a period of about eight years, demonstrated its extraordinary merit.

It was at once recognized, in view of the newly discovered agencies of destruction of rigid pavements, that this method of construction, using this character of asphalt as a filler, afforded sufficient flexibility, so that these forces operating with an upward thrust against the brick surface, had little injurious effect. It was proved by experience that this filler practically protected the edges of the brick equally as well as the cement filler. In the light of this knowledge there was but one thing to do, and that was to strongly recommend to the engineers and the public the use of this particular refined asphalt as a filler for brick pavements, as affording a quality subject to the least possible injury from either traffic or these natural agencies of destruction, and this in brief is the reason for the National Paving Brick Manufacturers' Association strongly recommending this method of construction.

It must be understood that the use of asphalt filler in no way obviates or lessens the necessity of carefully complying with the details of construction, which are so well understood to contribute to the worth and durability of a brick pavement. Nor is the mere use of this filler sufficient to realize the ideal pavement possible, unless the exact and proper refinement of the asphalt is used and it is properly and skillfully applied. Its use must also be accompanied by the skillful installation of other requisites of the improvement as a whole, which constitute and are necessary for the ideal finished pavement.

These requisites are unfortunately often either carelessly dealt with, or ignored altogether, and are bound to result in unsatisfactory pavements. It is essential, of course, that the filler be applied so that the joints shall be completely filled.

Other important details subject to neglect and oversight are:

First—The stabilization of the subgrade, by reducing to a minimum the possible moisture content.

Second—The smoothness of the artificial base.

Third—The uniform compression of the sand bed upon which the brick are placed. Unless compressed, the brick wearing surface will ultimately conform to any unevenness of the base surface. This requirement can only be accomplished by using a hand roller and filling the depressions noticed after each rolling. Three to four repetitions are necessary to accomplish the desired result. Compliance with these details will secure an ideal pavement, and avoid the impairment of the pavement of all possible destruction from contraction and expansion forces.

RESURFACING PAVED STREETS

By D. I. Elder, Currie Engineering Co., Municipal Engineers, Webster City,, Iowa

There is one economic question connected with this subject of resurfacing, which is: "Why is it necessary?" And the immediate reply is: "That the existing surface has failed." Then arises the question: "At just what stage of disintegration is resurfacing required?" And the proper answer to this question requires the exercise of considerable business judgment. It is not possible to set a rule that will hold in all cases, but each project requires consideration on the basis of the factors involved.

When to Resurface

In the first place, on account of the expense involved, it is advisable to put off the day of resurfacing as long as possible, if the pavement can be maintained in good condition by timely repairs. Not long ago, in one of the engineering periodicals, the experience of an eastern city was given, in which the subject of maintenance and resurfacing was taken up from the standpoint of management and accountancy. Records were kept for a long period of years showing the initial cost of each paving job and the annual repair bills for each. In that city it had become the rule that resurfacing was warranted as soon as the annual repair cost had crossed a certain line, the amount representing a tax sufficient to pay for resurfacing in the course of a few years.

Good Pavement Invites Traffic

A pavement has been defined as a base that is sufficient to transmit the load of traffic to the soil, and a surface that will resist abrasion. When, therefore, the pavement fails, it is necessary first of all to find out why, and to make the restored surface adequate for the needs as they exist and for those that can be forecast. In this connection I must say that a common experience in considering the plans for resurfacing an old street is as

follows: The argument is advanced that the cost should be kept as low as possible to permit the improvement being considered at all, and for that reason the type of surface and construction details should be specified with regard to rather light traffic, the statement being frequently made: "These streets do not have what you might call heavy traffic." The reply it: "That the traffic the restored surface is going to receive cannot be predicted on the basis of that now being routed over this street, for the reason that it is too rough to permit much traffic. As soon as a smooth surface is laid, then the chances are the street will be used more. A good street is an invitation to traffic." If a pavement has failed under one given set of conditions, it is well to assume that in future conditions will be even more severe.

Causes of Pavement Failures

At this point it is well to inquire into some of the general causes for the failure of some of the pavements that will require resurfacing, and in many cases the pavement is of an obsolete type. I have in mind particularly some of the old brick pavements that were laid without a concrete foundation, on a generous sand cushion and with a sand filler. Now, while such a pavement might have been all right for horse-drawn traffic for a time, soil shifting, trenching and uneven settlement of the sand cushion have left the surface in humps and depressions. In some cases the brick used were not as hard as are required for present practice, and the edges are badly chipped. Traffic over such streets is usually very light at the present time if any other routing can be found, and where this is the only practical route for traffic, the speed is reduced.

Construction Faults

Formerly, many thought that a 4 in. concrete base was sufficiently thick, and that the mortar could be somewhat leaner than that in use now. Also, it used to be the custom in laying a concrete base, when stopping work at night, to make a joint as follows: The last concrete that was poured was flattened out to a thin edge; then in the morning when starting work, the fresh concrete was poured on top of this thin edge poured the night before, and the surface carried from that point on. This made a sort of sliding joint, and it was thought necessary to provide for expansion and bridge the joint. But now some of these joints are found badly shattered or lapped, appearing in the surface of the street as a hump. Again, in cases of lean concrete it is often found that where cracks are formed by contraction, the concrete at the edges of the cracks is badly shattered, resulting from pressure when they have expanded again.

Inspection

Another general cause for rapid deterioration in pavements can be brought under the head of specifications, inspection and construction. Many pavements have failed because the specifications were drawn so as to permit the use of materials, mixtures and construction practices that were not suitable for the conditions to be met. Inspection includes the preliminary examination of materials, and the control of the mixing process in preparing them for the street. Sometimes inspection has been what we may term visual; for instance, the suitability of gravel might be judged by examining a handful taken at random from a pile. Construction engineering includes the supervision of the job while work is in progress; and some failures are to be traced to the fact that, where a certain depth of concrete was specified, something less has been secured, and other details of workmanship and finish have not been carried out as the specifications have contemplated.

Cheap Pavements

One further possible source of trouble is found in the following condition: Suppose an important street from a traffic standpoint to be bordered by vacant property that has a very low value for purposes of special assessment; such, for instance, as the street leading from the center of town to the team tracks at the railroad freight house at the outskirts, and that connects with the primary highway from that point. The most economical pavement for such a locality might be too expensive a type for the assessable property to pay for, and the needed improvement has to be built of a less expensive type with the expectation of later resurfacing.

Rebuild to Suit Traffic

Now this discussion of the causes for failure of a pavement leads up to the proposition that when the surface is finally restored, the pavement should be a permanent piece of construction designed to meet modern traffic. Before the plans for any resurfacing project can be decided, it is necessary to make a thorough

investigation of the existing pavement, and of the traffic conditions it will have to meet, and then decide what is to be done. Without such an investigation and plans made after mature consideration, the taxpayers may be disappointed in the short life of the restored surface.

Foundation Strength

Apparently the abrasive action of traffic is much less a factor in the destruction of the surface than was formerly supposed; and I believe it is now being recognized that the strength of the foundation is the biggest factor in the modern pavement. Therefore, in making plans for the restoration of the surface, the base or foundation is the first point requiring consideration. For, if additional strength is needed in the base and is not provided, difficulty is sure to develop later on.

Curb and Crown

Of course the height of the curb and the crown of the street will, in some situations, limit the plans for treatment of the surface. But consider the case of a pavement which was not originally designed to meet present loads, consisting of only 4 ins. of a comparatively lean concrete. Investigation may reveal such a shattered condition of the base that renewal of a flexible surface would be only a temporary improvement. It has been suggested that, in such a case, the addition of 3 or 4 ins. of rich concrete, finished for the new surface, be applied.

Brick Salvage

The treatment of old brick pavements requires special consideration in each instance. There is a possibility for some salvage in the brick if, upon examination and test, it is found that the brick are suitable. For if an uneven brick surface is due to shifting of a sand cushion and to broken edges, they may be taken up and laid with the worn edges down, upon a concrete base, with a sand cushion stiffened with a little cement, and with a bituminous filler. On the other hand, it may prove more economical to cover the old brick with an asphaltic type of surface, using an asphaltic concrete binder to fill up the depressions in the old surface and bring it up to the proper grade and crown.

Old Concrete Pavement

An old concrete pavement presents a variety of possibilities, except that the depth of the curb is a limiting factor. After repairing the broken places, and if the base is sufficient, an asphalt or a brick surface may be applied, or even an additional thickness of concrete.

Asphalt Pavements

Asphalt pavements, on account of the elasticity of the surface and its plastic nature, present another special problem. The usual condition of an asphalt street that has failed is that the surface has shoved under traffic, and has formed waves of such height as to give the impression that the base is broken and has turned up on edge. Usually, examination shows the base to be in good condition, but the asphaltic mixture so far disintegrated that water and frost are able to continue destructive action. Often the surface has broken out in places, leaving the base bare. It is often recommended that a thin layer of surface mixture be applied to a wrinkled surface, but this can be considered only a palliative, if the cause for pushing was the instability of the mixture used.

Topeka Mix

For many years a popular type of asphalt pavement has been the Topeka mixture, or asphaltic concrete, whose characteristic is that it is composed of crushed stone finer than ½ in., mixed with fine sand and asphaltic cement. After the wear of a little traffic, the coarse stones appear in the surface as a mosaic. The popularity of this type of mixture is that it is somewhat cheaper than others, while presenting a very smooth riding surface, and large yardages are in use and still being built. But it has been authoritatively stated that this type is tending to shove under traffic, unless it is laid on a binder. In bituminous pavements of the coarse aggregate type, one of the agents of destruction is water which penetrates along the edges of the coarse stones. And if the stones be of a porous nature, as limestone, frost completes disintegration. Some pavements of this type show a surface pitted with holes where stones had once lain. I believe it is the recognized principle of those now interested in the asphaltic concretes that the preservation of the surface is to keep it waterproof by the application of a hot sand and asphalt mixture, rolled on to form the wearing surface.

Asphalt Mixtures

In dealing with an asphalt pavement that has failed, the first necessity is to examine the existing mixture to determine its condition and grading. This is especially important. The art of asphalt

paving was developed in earlier years by a process of trial and error, good and bad pavements resulting. Later research conducted upon these older pavements has revealed the standards by which it is necessary to govern the mixtures and the construction details in order to build an asphalt pavement whose wearing qualities can be predicted with any certainty. An examination of the mixture from an old asphalt pavement that has failed usually reveals the fact that some of the standards have been violated. Exceptions are to be found in the case of city streets where the asphalt borders car tracks, and the traffic is so continuous that the normal wear of years occurs in a compaatively short period. The other extreme is the case of a street that receives almost no traffic, and the asphalt cracks because there has been too little traffic to keep it kneaded into a smooth surface.

In case examination shows that the mixture is faulty, there is only one remedy, which is to remove it and replace it with a proper mixture, properly constructed. On the other hand, especially in the case of pavements of the coarse aggregate type, if it is found that the composition is inherently stable, and that the surface is suffering only from the attack of weather, it may be restored by the application of an inch or more of a hot sand and asphalt mixture; in other words, a sheet asphalt mixture, that conforms to modern standards.

In many localities the resurfacing issue is becoming acute, and it is here desired to point out that in the past few years our paving standards have changed to meet conditions that were not dreamed of in the earlier years. So many possibilities for renewal are apparent to one who gives the matter thought that there is ample room for the exercise of good business judgment. Good engineering consists not only in constructing durable improvements, but in constructing durable improvements with the utmost economy consistent with good practice.

The foregoing paper by Mr. Elder was presented at the recent annual meeting of the League of Iowa Municipalities.

GRAVEL ROAD MAINTENANCE IN MICHIGAN

By B. C. Tiney, Chief Inspecting Engineer, Michigan State Highway Department, Lansing, Michigan

We have, in the trunk line and state rewarded road systems of Michigan about 12,250 miles of improved roads, of which about 9,250 miles, or 75 per cent, are gravel surfaced. The general distribution of gravel throughout the state, together with the comparative simplicity of construction and low first cost of this type account for the large percentage of gravel surfaces.

Since the advent of the motor car in large numbers, the maintenance of these gravel roads has become one of the most serious problems confronting highway officials of Michigan. The increase of the legal speed limit to 35 miles per hour has added further to the difficulty and cost of this maintenance.

The moisture content of the gravel is an important factor in the work of keeping the surface smooth, as shown by the ready formation of ruts and holes after a heavy rain and the tendency of the surface to ravel in very dry weather. The dry weather condition is probably the more serious, as it is usually coincident with the peak load of tourist traffic, and the patrol work is very ineffective without a certain degree of moisture in the surface.

Graders and Drags

Several types of graders and drags are used in patrol maintenance. A survey of this equipment in the state shows that 53 per cent of the counties are using horse-drawn machines entirely, while the others have either wholly or partially adopted motor equipment. The larger counties prefer the motor equipment because of the greater efficiency in covering a large mileage. The grader or drag pulled by a tractor, or the tractor and blade in one unit are used, but the most popular equipment, perhaps, is the two or three ton motor truck with a spring scraper attached underneath. This is very satisfactory if operated at a speed of not to exceed 8 or 10 miles an hour, but does less effective work at higher speeds. The spring scraper is used only for floating loose material, and should be supplemented by a heavy grader and tractor after rains, to plane the surface and eliminate ruts and holes.

Resurfacing With New Gravel

The gravel surface is also kept smooth by an occasional resurfacing with new gravel. A satisfactory material for this purpose is that ranging in size from ¾ in. down, and having about 75 per cent retained on a ⅛-in. screen. A partially crushed gravel has been found desirable. The application, if limited in depth to

about an inch, will not be objectionable to traffic, and this represents about the minimum amount of gravel that should be returned to the road each year to replace that which is worn away. The road should have a covering of about ½ in. of loose material at all times, for efficient floating.

Formation of Chatter-Bumps

One of the greatest enemies to smoothness in a gravel road is the oversized stone. Stone over 1 in. in size should be rigidly barred from the top course during construction, and certainly should not be permitted in any resurfacing material. The tendency of the large stone to work to the top by frost action is well known. Whenever a car strikes an obstruction such as a projecting stone, the springs are at first depressed and then expanded, lifting the weight of the car from the road. When the springs return to their original position the weight of the car strikes the road surface, causing small depressions. The spinning drive wheels also kick back some gravel and increase the tendency to form holes. This process continues and the holes grow rapidly in size and number until we have a whole series of corrugations or "chatter-bumps." Wet weather and flat grades are especially favorable to their formation, as water collects in the holes and is thrown out by the traffic, carrying fine binder material with it.

Dust Control

Perhaps the most disagreeable feature of the gravel road is dust. The discomfort not only to the motorist but to the resident along the road, together with the danger added to highway traffic by dust, make its elimination or reduction a matter of prime importance to highway officials.

On secondary roads having a traffic up to about 300 vehicles per day, the dust is not extremely objectionable. Our traffic census shows that of the 3,245 miles of trunk-line gravel roads, we have about 20 per cent, or 650 miles, carrying a traffic of less than 300. About 35 per cent, or 1,135 miles, carry a traffic between 300 and 600, while about 45 per cent, or 1,460 miles, carry over 600. A census of the county systems would probably show larger percentages in the lower traffic divisions.

Those gravel roads having a daily traffic of more than 300 vehicles demand some form of dust elimination or reduction if they are to render 100 per cent service to the public. Two forms of dust palliative have been used in Michigan, namely calcium chloride and light asphaltic oil. These two materials function in a similar manner. Their proper use does not permit of application in sufficient quantities to entirely eliminate the dust, as this results in the formation of a surface crust which soon breaks up into holes and necessitates scarifying. If applied in smaller quantities at more frequent intervals, however, the dust may be reduced to a point where it is not objectionable and still leave enough loose gravel on the surface to be floated back and forth in patrol work. A uniform covering of ½ to 1 in. of loose material over the road surface before applying the dust layer is very desirable. Sections not having this cover are observed to glaze over and then break up into holes within a few weeks.

Calcium Chloride

Between four and five thousand tons of calcium chloride are used annually in this state. The best practice is to apply from ¾ to 1 lb. per sq. yd. for the first application and ¾ lb. per sq. yd. for the second application, or perhaps make a second and third application of ½ lb. each, depending upon local conditions. A total of 2 lbs. per sq. yd. is usually ample to lay the dust for a period of 3 to 3½ months. The cost of this work ranges from $225 to $300 per mile for a season. In some sections of the state, traffic and local conditions are such that one application of about 1¼ lbs. per sq. yd., placed on an 8-ft. strip in the middle of the road, renders it fairly dustless for the season. The chloride on this 8-ft. strip is worked to the edges of the road by traffic and patrol work, and under this system the cost has been reduced to about $125 per mile.

Light Asphaltic Oil

Light asphaltic oil has not been used to any great extent in Michigan as a dust layer, it having been tried experimentally during the last three years. About 44 miles of road were treated in 1923. The oil used conformed to the State Highway Department's specifications for this material, and was applied by pressure distributor, without heating. The first application consists of 1-6 to 1-5 gal. per sq. yd. and renders the road fairly dustless for a period of about six weeks, after which a second application of about ⅛ gal. per sq. yd. is necessary. The re-

lation between the quantity of oil applied and the amount of loose gravel on the road is important. The above quantities would apply to a surface having a uniform covering of about 1 in. of loose material.

The most common error in oil treatment has been the use of too much oil in the second application, resulting in matting of the surface and subsequent roughness. The cost of two-application work in counties doing a rather small mileage has been about $400 per mile. One county which is particularly well equipped for doing this type of work, made one application on 41 miles of road this year at an average cost of $132 per mile. This was applied to a width of 12 ft.

Success With Dust Layers

Summarizing our experience with dust layers, we believe that the things most essential to their successful use are:

First—Proper control of the material by specifications.

Second—The presence of a uniform covering of loose gravel on the road before treatment.

Third — Application in sufficiently small quantities to avoid solidifying the surface.

We have some 1,400 miles of trunk-line gravel roads carrying a traffic of more than 600 vehicles per day, and ranging in some cases to as high as 3,000 per day. There are, in addition, some county gravel roads having a daily traffic in excess of 600. The ultimate solution in case of the heavy traffic gravel road is, of course, to reconstruct with a permanent type of pavement. The time required to finance and build this large mileage of pavement will necessitate the maintenance of some heavily traveled gravel roads for a number of years.

Bituminous Surface Treatment on Gravel

A partial solution of this maintenance problem may be found in the bituminous surface treatment on gravel, in the same manner as applied to macadam. We now have about 53 miles of this type of maintenance in the state. It cannot be successfully used on all kinds of gravel, and should be attempted mainly on those roads containing a high percentage of stone, thoroughly compacted. The nearer this approaches a macadam structure the better will be the results of treatment. A few of these roads received an initial treatment several years ago and have since been given lighter treatments. Twenty-six miles were given a first treatment in 1923.

The principles governing the surface treatment of gravel roads conform very closely to the established practice in surface treatment of water-bound macadam. In preparing the surface sufficient blade work should be done to eliminate ruts and holes. This work may be continued to advantage up to within two or three days of time of treatment, provided the gravel contains enough moisture to shape well. The surface is then thoroughly swept, removing all loose material and exposing the large stone. Particular attention should be given to cleaning the edges, and traffic should not be permitted to use the road between the time of sweeping and treating.

Bituminous material is applied first as a prime coat at the rate of about 2-10 of a gal. per sq. yd., and allowed to penetrate for 24 hours or more. The second application is made in the amount of about 3-10 of a gal. per sq. yd., followed by a cover of stone or slag chips or pea gravel.

The hand maintenance which must follow this treatment is best conducted by mixing some of the same bituminous material used in the treatment with coarse sand. This is usually done with a small concrete mixer at a central location and the mixture is stocked in small piles along the road. Small surface breaks are easily repaired with this mixture. We have found that on gravel there is more tendency toward surface peeling, the first year, than there is on macadam. One man, equipped with a wheelbarrow and shovel can, under normal conditions, keep about 10 miles of road in good condition. This patrol work should be followed up consistently.

Cost of Maintenance

The cost of maintenance of gravel surfaces having a daily traffic of more than 600, by the system of patrol graders, necessary resurfacing and dust palliatives, ranges upward from $600 per mile per year. A study of costs in a number of representative counties of the state would indicate that the relation between cost and traffic is, roughly, that the annual cost of this type of maintenance in dollars per mile equals the average daily traffic. That is, a daily traffic of 800 to 1,000 vehicles means an approximate annual maintenance cost of $800 to $1,000 per mile.

The cost of a bituminous surface treatment is about $1,000 per mile for the first treatment and $750 per mile for subsequent lighter treatments. We have reason to believe that not more than three treatments will be required in a period of four years, which would bring the average annual cost of treatment down to about $625 per mile. In addition to the surface treatment we have the patrol or hand-patching work, which will cost about $250 per mile, making a total annual cost of $875 per mile. This cost compares favorably with that of maintenance by the system of patrol graders, resurfacing and dust palliatives, for roads of 800 to 1,000 traffic. The bituminous treatment would probably be the cheaper method for roads of higher traffic.

Extreme frost action may necessitate scarifying and retreating some sections, but very little of this has been required on treatments of several years' standing, in this state. One or two failures of surface treatments on gravel have been partly due to lack of proper attention to details in placing the treatment, but largely due to the absence of patrol or patchwork, and these failures only serve to emphasize the importance of this latter phase of the work.

Aside from the consideration of cost, the bituminous surface treatment converts the gravel road into a higher type. It provides absolute instead of partial elimination of dust, and produces a good driving surface, free from loose gravel. Treatments placed this year have been highly commended by the driving public and the owners of abutting property. Referring to the surface-treated sections placed this year on Trunk Line 65, north of Ann Arbor, the Washtenaw County Road Commission, in its annual report, states that "no money ever spent for road maintenance in this county has given as much satisfaction to users of the road, as well as residents along the road."

The department feels that this type of maintenance, if properly handled, will provide a desirable intermediate step between the gravel surface and the pavement.

The foregoing paper by Mr. Tiney was presented at the recent convention of the Michigan State Good Roads Association.

CONTROL OF STREAM POLLUTION

By Charles F. Dalton, M. D., Secretary, Vermont Department of Public Health.

(Editor's Note: Following is the text of the report of the Committee on Sanitary Engineering of the Conference of State and Provincial Health Authorities, held at Washington, D. C., May, 1923.)

Streams since time immemorial have been considered the logical place for the disposal of all kinds of waste and refuse, and every community situated on a stream considers it its inalienable right so to use it, regardless of the effect it may have on a neighboring community. This practice has and still is so general and has been so persisted in that in many instances it has become a serious menace to public water supplies.

The importance of the control of stream pollution was very forcefully brought out in a Progress Report of Committe on Industrial Wastes in Relation to Water Supply, of the American Water Works Association Standardization Council, published in May, 1922.

This committee conducted studies of the effect of discharge of industrial wastes into streams on water supplies and tabulated the results by states. This shows that more than half of the states have suffered more or less damage to public water supplies on account of pollution by industrial wastes. To quote from this report, "with the growth of industries the injurious effects of industrial wastes upon water supplies and water purification processes are becoming more and more important. Serious troubles from this source have already been experienced in numerous places and water supplies are being menaced to a greater and greater extent by the discharge of industrial wastes into existing or potential sources of water supply. The subject of industrial wastes in relation to water supply is, therefore, very timely, and of vital importance"

Public Water Supply of Nation Threatened

It is the opinion of your committee that the above quoted statement is beyond refutation. Anyone at all familiar with the conditions cannot fail to see the grave danger threatening the public water supply of the nation, nor to recognize the necessity of proper control of disposal of wastes, not only from the industries, but of a domestic nature, so that the water supplies may be safeguarded. The above mentioned report shows an average of ten supplies each, in the states from which replies were received, have suffered from

this trouble, one state alone reporting 138 supplies affected. It states that "the extent of the pollution may be so great as to interfere with the ordinary water purification processes or actually to render such process incapable of producing a satisfactory water." It is not difficult to foresee what this means, if allowed to continue uncontrolled. Already cities have been put to great expense, to seek new sources of supply, when proper control of waste disposal would have been the wiser from an economic point of view. However, in the absence of proper authority or control this method has been rendered impossible.

Beet sugar refineries of Ohio have seriously affected the water supplies of that state, the State Board of Health reporting that "The vegetable organic matter increased the color and bacterial content of the water, and interfered with the filtration and chlorination processes. The ordinary purification facilities, including storage, aeration, coagulation, filtration and chlorination, were only partially effective in remedying the objectionable effects."

Pollution by Mine Drainage Serious in Some States

Pennsylvania and West Virginia have reported serious trouble from discharge of mine drainage water into public water supplies. Engineering and Contracting for Feb. 14, 1923, contained an article by Mr. J. W. Ledoux, Consulting Sanitary Engineer, entitled "Water Supply Contamination by Mine Drainage." It is a discussion of the situation in Pennsylvania, and brings out the seriousness of conditions from the water supply point of view. In some sections of the state the problem has already reached the stage where careful study is necessary to decide whether the sacrifice of the water supply or of the coal is best from an economic standpoint. It has been estimated by Mr. C. A. Emerson, formerly chief sanitary engineer with the Pennsylvania State Department of Health, that the cost to the State, of this pollution by mine drainage, is more than eight million dollars annually. In some instances it has been necessary to abandon a water supply and seek another source, on account of the acidity produced by mine wastes. The cost of chemicals for treating the water has been prohibitive, necessitating the procurement of another source of supply.

Phenol Wastes Difficult to Control

Another source of trouble, and one which is not dependent on natural, geological deposits to delimit its field, is waste from gas and coke plants and from wood alcohol plants. Milwaukee has suffered badly from tastes and odors in its water supply produced by wastes of this character. They are responsible for the so-called "creosote" odors and tastes in water, which are intensified by chlorine disinfection. As it is a generally recognized fact that all surface waters should be disinfected before use as a domestic supply, and as these "creosote" odors are noticeable even in very great dilution, one part of waste to ten million parts of water, the menace to water supplies from this source is apparent. At Milwaukee it was found that the tastes were produced by one part of waste in 500,000,000 parts of chlorinated water. It is evident that under such circumstances, natural dilution, especially in streams, cannot be relied upon to prevent trouble. According to the report of the Committee on Industrial Wastes in Relation to Water Supply, above referred to, no satisfactory method of water purification has been found, to eliminate the tastes and odors due to the phenol wastes. It has been found necessary to begin corrective measures on the waste before discharge into a water supply. At Milwaukee experiments with the activated sludge process of sewage disposal indicate that this will be able to protect the water supply even when the phenol carrying wastes in the sewage are very considerably increased.

Some sections of the country are affected by the salt water and crude oil from operation of oil wells. The discharge of salt water from oil wells causes the majority of trouble from this source. It not only pollutes the surface waters but in some cases, notably in Oklahoma, underground waters have been affected through adandoned wells which were ineffectively plugged. Oil refinery wastes also cause trouble. It is reported by Mr. F. M. Veatch that the Verdigris River has been so badly polluted by these wastes that at times it is impossible to wash dishes in the city water of several cities without leaving a taste on the dishes.

Examples of Stream Pollution Numerous

We have mentioned some of the most glaring examples of stream pollution by industrial wastes. It does not appear to your committee to be necessary to burden you with a detailed reference to result of contamination of water supplies by each individual type of industrial waste. The literature is replete with such illus-

trations, in fact, the bibliography on the subject would be nearly as long as this report itself. The problem has received recognition by communities, State Health Boards and by the Federal Health Service, and thousands of dollars have been spent in making investigations for the purpose of correcting existing evils of this character, or to find some means by which it can be prevented in other places. Many other types of industrial wastes may be as obnoxious as those mentioned above, for example, chemical manufacturing wastes, corn products wastes, dye wastes, leatherboard and strawboard wastes, wastes from munition plants, pulp and paper mill wastes, tannery wastes, textile industry wastes, both from woolen and cotton mills and many others are on record as having seriously affected the quality of existing water supplies, or rendered potential sources unfit for use. The States of Connecticut and New Jersey have made numerous investigations of streams, and practically every stream in those states has been found to be more or less seriously affected by wastes of one sort or another.

The States of Pennsylvania, Ohio, Minnesota, Wisconsin and others have found very similar conditions, and it is the belief of your committee that most of the states would find that many of their water supplies are facing a grave danger from this source if thorough investigations were made. In view of the fact that practically every kind of industrial waste may be considered as a potential source of pollution of water supplies, the importance of early recognition of this problem cannot be over-estimated.

Prevention of Pollution Most Important

It is not our intention to outline methods of correction of existing evils of this character, for two reasons. First, because no remedy has been found to correct the water after the pollution has occurred, and second, because each individual case is a problem by itself which can best be corrected after thorough study of conditions. Our object in discussing this subject is rather to bring to the health authorities a realization of the seriousness of the problem, in the hope that it may direct the attention of some of the less afflicted to the dangers ahead, so they may take steps to prevent a wholesale destruction of water supplies in their state. Boards of health are charged with the duty of preventing the preventable diseases, and of securing the people against unnecessary exposure to disease. It is also their duty to prevent conditions which cause disease. It is a well recognized fact that a good water supply is one of the most potent factors in maintaining good health. The work of preservation of the sanitary and esthetic quality of a public water supply is therefore, a logical and proper part of the duties of such health boards. The esthetic consideration is included because if a water, although safe from a sanitary point of view, is objectionable on account of tastes or odors or for some other physical characteristic, it may cause consumers to turn to other sources, which may not be safe, thus creating a strictly public health problem.

It has been learned that in most of the states where serious industrial waste problems have occurred, the state boards of health have some control, but in only five has ample authority been given the health authorities fully to control conditions. Practically all the states report that enforcement of the laws is materially hampered for lack of sufficient appropriations for field and laboratory personnel.

Three Lines of Procedure in Correcting Conditions

In general there are three lines of procedure for correcting unsatisfactory conditions due to pollution by industrial wastes, namely:

1. Purification of the water.
2. Treatment of the industrial waste before discharge.
3. Preventing the discharge of the wastes into the water supply.

The boards of health should have sufficient authority to compel the employment of one of these, but before ordering any particular community or industry to carry out any measures, a careful study should be made to determine which is the best remedy, giving due consideration to established industries.

Legal Authority and Adequate Appropriations Necessary

It is believed by your committee that the control of stream pollution for the protection of existing and potential water supplies is one of the most important problems with which the Sanitary Engineering Divisions of the State Boards of Health have to deal, and the health boards of our states should see to it that every effort is made to secure the enactment of laws to place in their hands the necessary authority to enable them effectively to control the situation, and to secure adequate appropriations to provide the necessary field and laboratory workers to carry out the investigations. A change of policy in some states will be

necessary, in order to give the public the protection to which it is entitled.

This is one of the many problems confronting the sanitary engineer in the state health departments, but in view of the trend toward destruction of all surface sources of water supply, it is believed to be of sufficient importance to take a prominent place in our report. It is hoped that this presentation of this subject will stimulate discussion which will be of help to those states which are not yet seriously affected, to the end that they may institute preventive measures and thus avoid the difficult and expensive corrective measures to which some of our states are already put.

CONSTRUCTION OF OUTDOOR SWIMMING POOL AT CEDAR RAPIDS, IOWA

By Howard R. Green, Consulting Engineer, 208 Bever Bldg., Cedar Rapids, Iowa

The factors governing the design of a large, outdoor swimming pool built this year on the grounds of the Country Club at Cedar Rapids, Iowa, were as follows: To fit the finished pool into the rugged topography of the location with natural effect; to build a pool sufficiently large to accomodate some 350 members and their families, providing ample separate areas for the use of swimmers of varying ability with safety and convenience, and to keep the expenditure for construction under $10,000.

The location reserved for the pool was a natural ravine, cutting through a 100-ft. bluff along Indian Creek. The channel of the ravine sloped toward Indian Creek at the rate of about 14 ft. in 100. The sides of the ravine rose from a rounding bottom at the rate of about 20 ft. in 100. The pool as built in this ravine is pear shaped and measures 138 ft. along the axis of the ravine and 120 ft. in maximum width. The lower end of the ravine was dammed by the construction of a circular wall having a radius of 50 ft. for most of its length. The total length of the wall is 150 ft., the top being 1 ft. above water level and the central 48 ft. having a height from top of wall to top of footing of 13.5 ft., giving a maximum water depth of 12 ft. The footing from the ends of this central maximum section rises at a uniform grade until, at the extreme ends, the height of the wall is 1.5 ft. from top of footing to top of wall. The length of the water line around the edge of the pool is approximately 400 ft. and with the exception of the walled portion, the floor slab gradually rises to form a beach, the maximum slope being 1 to 2½.

The shallow end of the pool has an area of 2,600 sq. ft. varying in depth from 1 ft. to 2.7 ft. This area is separated by a rope and floats from the rest of the pool and is reserved for the use of children. The next area of 2,600 sq. ft., ranging from 2.7 ft. to 5 ft. in depth, is used by novices and affords a straightaway averaging 25 ft. by 90 ft. of swimming depth. A deeper swimming area ranging from 5 ft. to 8 ft. in depth, having an area of 3,500 sq. ft. affords a space of approximately 30x90 ft. for competitive swimming events. The remainder of the pool, which is the only portion bounded by the wall, provides 2,600 sq. ft. for diving, the depth ranging from 6 ft. to 12 ft. and there being 107 ft. of wall with 6 ft. or more water depth. Two spring-boards and a diving tower are symmetrically located at the deep end of the pool, all inside the 12-ft. depth line.

Around the outside edge of the beached portion of the pool, a gutter varying in depth from 6 to 10 ins. acts as a scum gutter for the pool and an intercepter for storm water flowing from the terraces

VIEW OF LARGE, OUTDOOR SWIMMING POOL OF CEDAR RAPIDS, IOWA COUNTRY CLUB

around the beach. Four catch basins carry off the water from this gutter through 8-in. vitrified tile lines and four ¾-in. galvanized pipe lines constantly play water into the gutter to furnish a foot wash for the bathers entering the pool. The entrance is at the shallow end and is approached by concrete stairs coming down the terrace. Sub-drainage is afforded by one line of 8-in. vitrified sewer pipe encircling the entire location and a gridiron of 4 and 6-in. tile laid underneath the floor. These tile lines are laid in trenches 3 ft. deep in the clay subsoil, No. 2 sewer pipe being used with no joint filler and the trenches being back-filled with coarse river sand. The sub-drain lines and gutter catch basins are all brought to one common outlet which affords an opportunity to gauge the amount of leakage and in case of serious break in the floor, the pool could be drained before any great damage was done. Fresh water flows into the pool at the shallow end through a 4-in. city water main, which is valved and metered in a control manhole concealed in the terrace. Gravity drainage is provided at the deep end through a 12-in. cast iron main running about 40 ft. beyond the limit of the pool from the end of which the water falls some 50 ft. to Indian Creek. From this 12-in. drain line between the valve and the wall, a 6-in. line runs to a pump and a chlorinator house, where a motor-driven centrifugal pump with a capacity of 450 gals. per minute forces the water through a 4-in. cast iron line around to the shallow end of the pool, where it tees into the fresh water supply line. In the pump house is located a liquid chlorinating outfit treating the water immediately after leaving the pump.

VIEW OF ONE SECTION OF NEW SWIMMING POOL AT CEDAR RAPIDS, IOWA

Construction

As soon as the site was cleared of trees, the excavation for the wall footings was made by hand. It was deemed advisable to place the concrete of the wall in one continuous operation. The footing varied from 8 ft. by 16 ins. to 5 ft. by 12 ins. At the junction of the footing and the 12-in. wall, the footing rises at 45 deg. for 1½ ft. on both sides of the wall. In order to effect continuous operation, therefore, concrete supports 3x1 ft. in area and varying from 3 ft. to 2 ft. 6 ins. in height were constructed along the line of the wall at about 10-ft. centers. On these supports the wall forms were constructed and from the plate resting on these concrete supports, the forms for the 45 deg. bevels are hung. In order to bond these pedestals to the wall, steel dowels were used and beveled 2x4's were set in the sides and removed before the final placing of concrete. The wall contained 100 cu. yds. of concrete, which was placed in one 12-hour run.

Immediately after stripping the forms, the inside face of the wall was smoothed with carborundum bricks and the excavation for the main portion of the pool was started. The equipment used was two Maney wheeled scrapers drawn by a caterpillar tractor. The material was deposited in thin layers behind the wall and compacted by subsequent trips of the tractor and wheelers. Operations continued until the fill had reached the top of the wall to a width of 10 ft., after which the fill was built by dumping over the edge. When the sub-grade under the floor was practically finished, the sub-drain lines were laid and back-filled with sand.

In order to get a water-tight connec-

tion between the floor slab and wall, a 1x2-in. cypress strip was inserted in the vertical face of the concrete wall footing, 3 ins. below the top of the footing. The excavation was notched against the face of the footing so that the concrete floor slab extended 6 ins. below this strip. Another strip was laid against the beveled footing at grade of the top of the floor, the floor slab being 6 ins. in thickness on top of the horizontal footing slab. Concrete was mixed at the shallow end of the pool and hauled to location in Ford dump trucks, hauling approximately 12 cu. ft. The surface was given a wood float finish in order that it might not be slippery under water. The wood strip at the wall connection was removed and the joint filled with asphalt. Three construction joints between day's work were built by a cypress strip embedded in the body of the concrete with an asphalt-filled notch immediately above it. One-half-inch square steel rods at 3-ft. centers both ways were used to reinforce the floor slabs and these rods were continued through the construction joints. When completed, the pool had the appearance of an immense spoon with the end cut off by a circular vertical wall. The capacity of the pool is approximately 400,000 gals. The terraces around the beach were cut back at about a 1 to 4 slope and sodded.

The pool has been in use since July 1, 1923, and from the results shown, it appears that most of the objects desired have been accomplished. The fact that there are no step-offs except where the wall serves as a warning and that the floor slopes gradually from the water's edge, has served to minimize accidents, as was hoped. An 8-ft. square float anchored at the center of the wall circle also acts as a safety device, it being approximately 50 ft. to the shore or shallow water in any direction. The total cost of the pool, including pumping and chlorinating equipment, was $9,800.

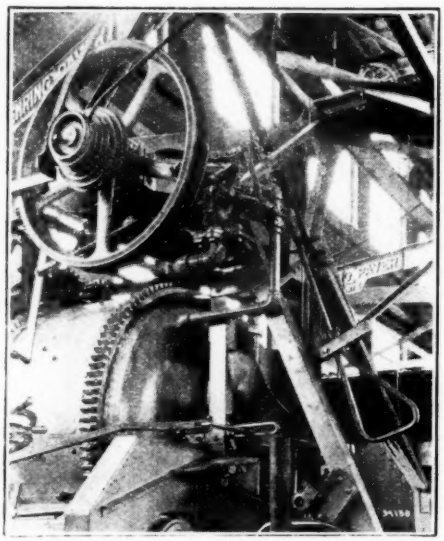
KOEHRING COMPANY ANNOUNCES NEW BALANCED VALVE

A new three-way balanced valve, the culmination of years of study and experimentation, has been perfected by the Koehring Company of Milwaukee and is now installed as standard equipment on Koehring 21E pavers.

Work on this new valve was begun in 1915 to overcome the difficulties of the old three-way valve with a metal-to-metal seat which never was wholly satisfactory, due to unavoidable leakage when the water which contractors are forced to use contained hard substances which cut the metal contacts.

This new valve completely eliminates this trouble as there are no metal-to-metal seats. All of the valve parts which come in contact with water are made of either bronze, brass, rubber or leather, preventing corrosion. It is balanced, automatically operated, permanent, non-freezing, self-draining and completely accessible.

The rubber valve discs and the leather plunger which receive the hardest usage, were removed from some valves that had



NEW THREE-WAY BALANCED VALVE NOW STANDARD EQUIPMENT ON KOEHRING 21E PAVERS.

been in service for several seasons. They were still in good condition and were continued in service. These rubber discs and leather plunger are standard Jenkins parts carried in any hardware store.

Inspection of the valve can be made very easily. Merely remove three bolts and one pin connection and the entire unit can be pulled out of the valve body. The valve can be dropped back into place without any fitting, adjusting or worry. To turn the three bolts down and make the pin connection to operating levers, is only a few minutes' work. The

valve is remarkable for its easy accessibility.

A removable house protects the valve and outside valve parts from stone, sand and cement which may drop from the charging skip.

An additional time-saving feature is the automatic opening of the valve to discharge water into the drum. The illustration shows the valve installed on a paver and the arm which opens the valve when the skip is raised. The time of opening the valve is adjustable in the valve operating mechanism. A hand control is also provided for operating the valve. The valve is balanced because the pressures are equal, which allows its easy operation.

For two years this type of valve has been installed on Koehring pavers in the field, functioning under the usual severe conditions under which a valve must operate. These valves were then returned to the factory from time to time for inspection and improvement. The valve now announced is the result of these years of expert designing, experimentation and test and is the last word in a paver three-way valve design.

The Koehring Company in addition to its line of concrete pavers and construction mixers, manufactures also cranes, draglines and power shovels.

SOME RECENT DEVELOPMENTS IN WATER SUPPLY PRACTICE

(Editor's Note: The following summary of the principal activities in the water works field, as related to the designer, builder and operator, is from the annual report of the Committee on Water Works and Water Supply of the American Society for Municipal Improvements. Members of the Committee are: George W. Fuller, Edward E. Wall and George G. Earl.)

1. The past year, and particularly the present autumn, has brought great anxiety to many water works officials owing to the protracted droughts. This applies particularly to the northeastern section of the country, in the New England and North Atlantic States. In the suburbs of New York, industries have been shut down for lack of water and neighboring cities have been called upon to help out adjoining communities, where this is practicable, to relieve the misfortunes of a water famine which are seldom, if ever, appreciated by the public until such a calamity befalls them.

2. The past year has continued to be an active period in the extension and addition to water works plants which all over the country are found in various stages of development. This is largely a result, of course, of the period of relative inactivity during and shortly after the war, although prices of labor and materials are higher than they were a year ago and are now about double prewar prices. There are many sections of the country where water works betterments are receiving more attention than for several years previously. Water shortage, threatened and actual, adequately explains this situation.

3. Real steps in the acquisition by municipalities of privately owned water localities. This is particularly true in the vicinity of New York, where agitations for years and decades at some plants have come to the front in some places have finally produced an agreement as to terms for acquisition. In part this is related to the need of bringing to an end deadlocks or disagreements as to a future program where the private company could not or would not provide needed extensions and where municipalities have held back with a view, in some cases, of picking up bargains in water plant purchases. Where factions have gotten together and agreed on terms of purchase, the figures, in most instances at least, have not approached either of the extremes earlier discussed.

4. Allocation of watersheds to different subdivisions of the states in the northeastern portion of the country is receiving more and more attention. This becomes a necessity as large cities in the Boston, New York and other districts find themselves obliged to look ahead to meet the growing needs of water supply at a date when the construction period already approaches the time remaining up to the date when additional supply must be forthcoming to guard against water famine.

5. Mechanical filters were introduced in Atlanta some 30 years ago on recommendation of the late Dr. Rudolph Hering. This type of filter, which is embodied in recent local extensions, has come into more and more general use. It has even entered the field in New England, where there is a new plant of this type recently put in operation at

Cambridge, Mass. Mechanical filters will also be used for the new water supply of Providence. They are also a part of the water purification projects at Albany and Poughkeepsie, N. Y., deriving their supply from the polluted Hudson River water. The raw water is first passed through a complete plant of the mechanical type and then through filters of the slow sand type.

6. The injunction suit, whereby the Mountain Water Supply Company sought to enjoin the discharge of coal mine drainage into the streams tributary to Indian Creek reservoir, was denied. An unusual amount of attention has been devoted during the year to the control of industrial wastes, particularly in Pennsylvania, where the jurisdiction of various state departments coming in contact with stream pollution has been reorganized by the creation of a new "Sanitary Water Board," having statewide jurisdiction.

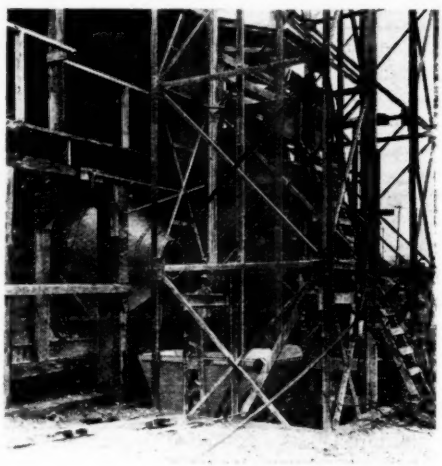
7. The newest step in the field of water treatment is the use of an iodin salt at Rochester, N. Y., for combating endemic goitre. This is in conformity with the recommendations of Dr. Goler, the City Health Officer. A two weeks' application of sodium iodide at the rate of 0.64 pound per million gallons has already been carried out by the Water Bureau there. It is expected that similar treatment twice a year of the public water supply of 25 million gallons daily will eliminate goitre, so prevalent in that city. Estimates place the number of preventable cases of goitre among children in Rochester each year at 2,000. This treatment is based on the correction of a deficiency in iodin found in certain waters of the Great Lakes regions and in the snow waters of Switzerland.

8. The new government standard for the quality of public water supplies used by the railroads and steamboats in interstate traffic has not yet been finally determined upon. Data from various localities throughout the country have been correlated and discussed for the consideration of the special Water Standards Committee appointed by the U. S. Public Health Service. This important step has revealed the fact that there are unfortunate instances where laboratories do not use the same methods of analyses and where those who express opinions on the results of analyses do not fully appreciate what the local data actually signify.

9. An important step in the unification of methods in handling the program of water standards is the conclusion of working committees of the American Public Health Association and of the American Water Works Association that the next edition of Standard Methods of Water Analysis should be gotten out jointly by these two associations. Authorization of such a step has been made by the governing bodies of the two associations, subject to the ratification of working details to be formulated jointly by the representatives of the two associations.

CONCRETING JONES ISLAND SEWAGE PLANT AT MILWAUKEE

Averaging 400 cu. yds. a day, two electrically driven Smith 40-S concrete tilting mixers are steadily advancing the work on the big sewage disposal plant at Jones Island, Milwaukee. It is expected that this job, which will require 64,000 yds. of concrete, will be completed about Dec. 1, 1923.



TWO ELECTRICALLY DRIVEN SMITH 40-S CONCRETE TILTING MIXERS CONCRETING JONES ISLAND SEWAGE PLANT.

These two mixers, each with a batch capacity of 1½ yds. and with batch hoppers, water tank and batch meter, are situated as the central units in the large mixing plant maintained on one of the long sides of the job. Extending in radial lines from this central mixing plant, chutes carry the concrete to all parts of the work, which, having outside dimensions of 650x750 ft., with the highest

point of concrete averaging 20 ft., gives some idea of the speedy and steady output required from the two mixers.

The job, which will cost well over three quarters of a million dollars by the time it is completed, is being directed by the Du Pont Engineering Co., of Wilmington, Del.

In addition to the two Smith 40-S tilting mixers, the central mixing plant includes two Insley steel hoisting towers of 1½-yd. capacity and 216 ft. high, so arranged that power is supplied to both hoists by one 100 H.P. double drum Thomas electric hoist. The aggregate is fed into the mixers from two overhead bins, each about 100 yds. capacity, these bins being fed by two 100-yd.-per-hour capacity bucket chain elevators. These, in turn, are fed by automatic chain belt feeders. The entire bin feeding apparatus is electrically driven.

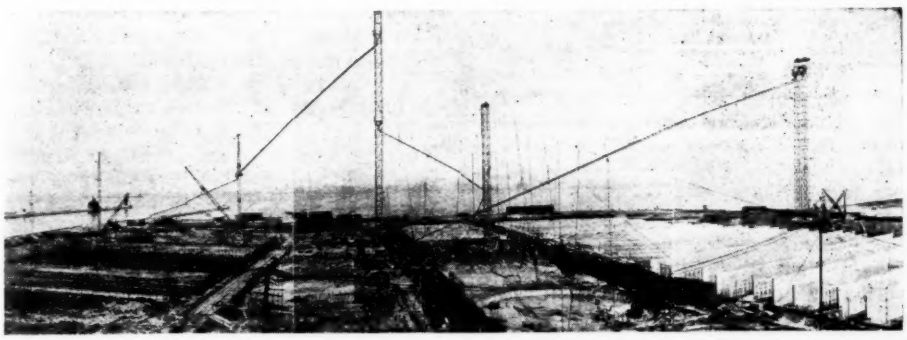
When available, bottom dump cars deliver the sand and gravel direct to the bottom of the bins. When other cars are used, a 1-yd. clamshell derrick unloads the cars, this derrick also being used in handling the material for the 1,000-yd. stock pile which is maintained.

A cement bin of about 2-car capacity is located close to the bins, this being used for emergency storage only. A gravity trolley system, with cement containers of the bottom dump type, each about 8 bags capacity, is constantly dispatching the cement to the mixers direct from the cement cars as they arrive.

From the mixing plant the concrete is conveyed to the various parts of the job by a series of hoisting towers and several lines of chutes. The two main towers at the mixing plant supply one line of chutes 450 ft. long to an Insley re-hoist tower 196 ft. high. This re-hoist tower in turn supplies a 120-ft. tower, placed in the center of the job, which supports a line of chutes 280 ft. in length on each side of the tower, with a 50-ft. counterweight chute on each end which is used to pour the circular tanks in the center of the job.

An Insley guy derrick of 10-ton capacity, with 115-ft. mast and 100-ft. boom, which supports a double counterweight chute system with total operating radius of 170 ft., is being placed in four different working set-ups, and is supplied with concrete either direct from the two main hoist towers or from the re-hoist tower.

Williamsport cable is used throughout the job, the main suspension cable being 1½ ins. in diameter, the rest being 1¼ in. or 1⅛ in.



PANORAMIC VIEW OF JONES ISLAND SEWAGE PLANT UNDER CONSTRUCTION

The two Smith tilting mixers are being operated alternately, and with specifications calling for 1½-minute mix, have reached a maximum of 600 yds. per day in one continuous pouring. The average per day, however, during the length of the job, has been 400 yds.

EVIDENCE IN ZONING CASES

By Frank D. Stringham, Mayor, Berkeley, California

The law of this country is undergoing some very rapid changes—and in at least two departments of government without any change in the Constitution of the United States. I refer to zoning and to public utility regulation. Public opinion is the controlling factor in these matters. I have heard many lawyers say in the past ten years that they thought that the greater part of these so-called zoning laws were unconstitutional, and yet these same lawyers are coming to recognize that they have a fight on their hands

when they seek to resist them. I recently tried a case in the Supreme Court of Alameda County in which the city was attempting to keep in a residence district, a lot which adjoined a retail business district and opposite which stores were located. The court declined to hold any part of the zoning ordinance unconstitutional, although it held that this particular lot could not reasonably be included in the residence district. I had at all times during the trial let it be distinctly understood by the court that there was a distinction between holding the law unconstitutional and holding it unreasonable in its application to a particular piece of property.

People for Zoning

The people have come to comprehend, through the activities of zoning experts and repeated hearings before councils and commissions, that entire blocks or districts of a city may become blighted by the unrelated use or misuse of property, and that great economic loss may result. They have learned that this can be stopped by zoning regulation. The people learn these things quickly, just as the employer and employes in the various states in an incredibly short time learned that workmen's compensation acts were good and protected both employe and employer.

There are a few states where zoning laws have by far the best chance of being sustained by the courts and I would include in this category, California, New York, Massachusetts and Minnesota. That is because these communities have been better educated in the operation of districting laws.

Six years ago I published an article in which I said, "We want to keep out of court until the reasonableness of the law is better understood, and the practical operation of the plan has been tested by actual experience," and we did keep out of court for five years, to our great advantage.

A Job for Experts

Anyone interested in zoning or "graduated regulation" and who as city attorney or as a member of a council has to make, amend or defend zoning regulations should either employ an expert to assist him in making a decision or study the general principles of districting so that he can intelligently apply those principles to any given state of facts. Exceptions have to be made in difficult situations, but we should always keep it in mind that hard cases make bad laws, and are certain to be cited against and embarrass you later. It is safer and wiser to follow established rules of action than to make exceptions.

If you are compelled to go to court be sure and make it clear that even if it finds against you it is not necessary for the court to hold the zoning law unconstitutional. Introduce as part of your case as many specially prepared maps as possible showing the extent of zoning in your city, and maps of the smaller area in controversy with the character of the improvements shown by color or otherwise, and let the court see the extent of work done and effort made. We put in evidence testimony showing the number of preliminary hearings had before the council and of public meetings in the city in adopting the comprehensive zone ordinance, and also put on the stand the fire chief, a city planning consultant, a fire insurance adjuster, and a real estate man, all of whom qualified as experts, and through them proved that zoning contributes to the public health, welfare and safety, and attempted to prove that the same would be subserved by excluding retail stores from the lot in question. The court allowed, over objection, all the hypothetical questions to be answered.

Some Hypothetical Questions Used

I will give one or two examples of the hypothetical questions and answers which were allowed by the court to go in as evidence:

Real Estate Expert:

Q. I will ask you if a municipality has by legislation zoned a city into residential, business and factory zones, and said city has a population of sixty or seventy thousand people in it, and an area of approximately nine square miles. if in your opinion would such legislation, assuming, that it was based upon proper surveys and investigations, tend to increase and stabilize real estate values in that municipality?

A. Decidedly yes. It substitutes orderly development for haphazard growth, and without question helps to stabilize and increase values.

Q. Assuming that such legislation created so-called residential zones or districts from which retail stores and factories, generally speaking, were excluded, would the creation of such residential

district, in your opinion, promote the general welfare of the community?

A. Yes.

Insurance Expert:

Q. I want to ask you one question: Speaking from your general knowledge of fire insurance rates and the fire hazard with relation to various kinds of buildings, is or is not the risk of fire greater in buildings used solely as dwelling houses or in buildings used as a dwelling house in combination with stores, assuming that all other conditions are similar?

A. The physical and potential hazard of a store is measurably greater than that of buildings occupied solely for dwelling purposes.

Q. Would the rate of insurance on that building, on a concrete building on that location, be greater if it had stores in it than if it did not have stores?

A. Yes.

Fire Chief:

Q. In your opinion, is the fire hazard greater in any apartment house or hotel if stores are maintained in connection therewith than there would be if there were no stores in the apartment house or hotel? Is there any difference?

A. Yes, in stores, of course, it would depend a whole lot upon what the stores were to be used for. You take in most any mercantile establishment, there is always packing and unpacking of goods, and there is always more or less inflammable material around; and then another reason is that in a residential district there is somebody there at night, at all times, day and night, and in the mercantile district, as a rule, after stores are closed, there is nobody there that will discover a fire.

City Planning Expert:

Q. As an investigator of municipal housing conditions, and city planning and consulting, I will ask you if, in a city having a population of fifty or sixty thousand inhabitants, and having a total area of nine or ten square miles, an ordinance were in effect and in force dividing the city into residential, business and factory districts, and in such residential districts no new business stores of any kind were permitted to be built or maintained, whether or not, in your opinion, such enforced regulations would tend to promote the public welfare and safety?

A. I should say that, in my opinion, it would.

A Marked Achievement

The manner in which a comparatively small body of men have, in an incredibly short time, created a strong public opinion in favor of zoning is one of the most marked achievements of the last 20 years. In less than five years the courts, which are the most conservative of our governmental agencies, have come to recognize the validity of reasonable zoning regulations, such as those prohibiting business in residence districts and factories in business districts.

The United States was slow to start any application of the principle of use regulation, but having once accepted the doctrine, a large number of states have seized upon it with avidity and even carried it in some instances to dangerous extremes. In our enthusiasm for what our aesthetic taste demands we should constantly guard against exacting such a contribution from the individual, for the public good, that a good portion of his property is taken away from him without either compensation or benefit.

Essentials to Success

The success of zoning will therefore depend largely upon the wisdom of our local municipal councils and boards of trustees. A councilman or trustee, like a judge of the court, must be fair-minded and be able to sift out and weigh the relevancy and importance of evidence. I think he should suspend judgment until the case is fully heard and not make up his mind beforehand in executive session, or in committee of the whole. A judge does not try his case in chambers before the case is tried in court. I emphasize this matter because a council sitting in zoning cases is exercising semi-judicial functions, and the people will never be satisfied unless a council acts fairly and according to well settled principles. Your zoning case in court will have a better chance if the council has previously followed some city plan, or general rule, and not made compromises creating exceptions.

Police Power Abused

Recognizing the tremendous force of public opinion even in the face of constitutional limitations, I sometimes fear for the outcome of the exercise of the police power. Under the cloak of legal authority I have seen property practically confiscated for public use without much hope of redress, and perhaps even without the present knowledge of the

owner. I think that zoning regulations should be liberal in its first application to an unregulated area, and approach gradually its ultimate logical form. One has a better standing in court if the legislative body has been reasonable, if it has given the citizen a fair and ample hearing, and has treated all parts of a city with equal consideration.

There is no cheap way of zoning a city. The city must be prepared for an additional expense in employing experts, providing maps and publishing ordinances with amendments. The compensation for this outlay is the increased value resulting from better adapted uses of property and also the greater comfort and welfare of the community.

I am not attempting a technical discussion of legal authorities, or to describe different kinds of zoning laws. I assume that it is desirable that all cities should be zoned, and that the only reason any city has not adopted it is that it is not ready to incur the expense, or there is no one in the city who is qualified to educate the citizens to the point of demanding it. Two years ago this was a more difficult task than now—for there is a richer field of experience to draw from and the most obvious and best argument to be used in any campaign for charter amendment or zoning regulation is that other cities have done the same thing and operated most successfully under such amendment or regulation. I do not hesitate to say that the sooner any city has a reasonable zoning law, the better it will be for that city, and the expense will be proportionately less is taken early.

The foregoing paper by Mr. Stringham was presented before the recent annual convention of the League of California Municipalities.

VALUABLE TRADE LITERATURE

(Editor's Note: Copies of these catalogs and bulletins may be obtained on request by writing to the addresses given in the reviews, or by writing to Municipal and County Engineering.)

De Laval Flexible Coupling—The De Laval flexible coupling is described in a 12-page pamphlet issued by the De Laval Steam Turbine Co., of Trenton, N. J. This coupling, which has been developed for turbines or other motors geared or direct coupled to pumps, generators and similar machinery, consists of two opposed flanges mounted on the driving and driven shafts respectively. One flange carriage carries bolts or pins which enter holes bored in the opposing flange, but not coming into metallic contact with the latter, as the driving force is transmitted through steel lined molded rubber bushings slipped over the pins. The rubber supplies the flexibility required to take care of inevitable slight misalignment, does not require lubrication, absorbs shocks and is long lived and reliable. There is no constraint upon independent endwise motion of the shafts, and one shaft can be removed without disturbing the other. The peripheries of the flanges are ground to true cylinders and the faces to true planes to facilitate lining up. All parts are made to limit gauges and all similar parts are interchangeable.

Snow Removal Equipment—"The Caterpillar for Snow Removal" is the title of a 16-page pamphlet issued by The Holt Manufacturing Co. of Peoria, Ill. Many pictures of the equipment in operation are shown. There are several letters from users and much other informative matter on the art of snow removal and its economic justification. Caterpillar snow plows are fully illustrated and described. Brief specifications on caterpillar tractors of various sizes are also given.

Truscon Metal Lath Data Book....This is a 48-page book recently issued by the Truscon Steel Co., Youngstown, Ohio. It is the most complete book ever published on metal lath. It is the result of an investigation covering more than a year. During that period nearly all the practical uses of metal lath were studied. The full pages of architectural details are not built on theory but on practical experience in the field. The specifications used throughout are adopted from those compiled by the principal metal lath manufacturers with the co-operation of the American Specification Institute. Solid plaster partitions, walls, floors, roofs, attached and suspended ceilings, together with practical information for interior plastering and exterior stucco work, are just a few of the subjects that are fully covered. The Truscon Metal Lath Data Book meets the requirements of the practical plastering contractor as well as the architect or engineer seeking technical information. The book is replete of tables of loads and

properties of all types of Truscon Hy-Rib Metal Lath. The distinctive thing about this data book is that it contains only the boiled down essence of practical metal lath information.

Concrete Mixers—The T. L. Smith Company, Milwaukee, Wis., is distributing a small folder descriptive of two of the Smith line of concrete mixers—the new 4-S Tilter (half-bag) and the 7-S Non-Ttilting Mixer (full-bag). Special reference is made to the newly designed and much simplified device which is now used on the 7-S for operation the discharge chute.

Underfeed Stoker—The new model Westinghouse Underfeed Stoker is illustrated and described in a 16-page catalog recently issued by the Westinghouse Electric & Manufacturing Co., Stoker Dept., South Philadelphia Works, Philadelphia, Pa. This model is the culmination of 35 years' experience in building mechanical stokers. This multiple retort stoker gives positive control of the fuel bed at all rates of combustion. An agitating element provides a means of maintaining minimum loss due to combustible in the refuse. Many types and sizes are illustrated in the catalog, including double and single dump grates and double and single roll ash discharge devices.

Lime Plaster Specifications—"Standard Specifications for Lime Plaster" is the title of Bulletin No. 305, 16 pages, recently issued by the National Lime Association, Washington, D. C. This bulletin is the result of several years' study of field conditions and has been prepared in conjunction with representatives of the engineering and architectural professions as well as expert plasterers and producers of lime. The specifications are in such form that they may be quoted directly and included in an architect's complete building specifications, or, if desired, the short form may be used and the contractor referred to the standard specifications. This new bulletin is 8½x11 ins. in size and marked for standard A. I. A. filing. Each specification is on a separate page and the arrangement is logical and simple. The bulletin contains only specifications.

Street Lighting—The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has printed in booklet form a paper entitled: "Bright Streets Are Busy Streets," presented by Mr. L. A. S. Wood of the Westinghouse Co. at the 28th annual convention of the International Association of Municipal Electricians. Some of the interesting subjects discussed by Mr. Wood are City Zoning of Street Lighting, Street Lighting Defects and Their Remedy, the Economy of Good Street Lighting, and the Effect of Good Lighting on Property Values. Copies of this leaflet, which is known as Reprint 166, may be had upon application to the Westinghouse Co.

Brick Paving—"The A B C of Good Paving" is the title of a 16-page booklet recently issued by the National Paving Brick Mfrs. Assn., Engineers Bldg., Cleveland, Ohio. The following subjects receive special attention: Wearing Surface, Base and Subgrade, Drainage, and Artificial Bases.

Paving Guards—Godwin Steel Paving Guards are illustrated and described in a 4-page pamphlet issued by the W. S. Godwin Co., Inc., 12 E. Lexington St., Baltimore, Md.

Water Filters and Filtration Equipment—This is the title of Bulletin No. 105 recently issued by the Permutit Co., 440 Fourth Ave., New York. It contains 24 pages. The data given is comprehensive and authoritative and fully covers the theory and practice of modern filter design and construction and shows, by detail drawings, the method of operation.

Power Drag Scrapers—The Sauerman line of power drag scrapers is illustrated and described in pamphlet No. 20 recently issued by Sauerman Bros., 438 S. Clinton St., Chicago. It contains 32 pages and is very fully and attractively illustrated with detailed views of the equipment and its operation. Special attention is devoted to Direct Loading to Cars and Trucks, Small and Medium Gravel Pit Operations, Large Sand and Gravel Pits, Making Cuts and Fills and Grading, Stripping Overburden and Similar Work, and Storing and Reclaiming Loose Materials. Valuable ideas are given on adapting the equipment to many difficult and unusual jobs.

Lime in Construction—This is the title of Bulletin 306-A, of 80 pages, issued by the National Lime Association, Washington, D. C. It relates particularly to Mortar, Plaster, Stucco and Concrete. It shows by observation and test data from quoted authorities he durability of lime, and its insulating properties, adequate strength, working qualities and economic advantages.

Lime in Concrete—This is the title of

Bulletin No. 308 issued by the National Lime Association, Washington, D. C. It contains 24 pages. The use of lime in concrete as approved by engineers, architects and contractors is illustrated and described.

Road and Street Maintainer—The "Gray Giant" combination road and street maintainer is illustrated and described in a folder issued by the Gray Tractor Co., Inc., Minneapolis, Minn.

Asphalt in Highway Construction—"Uses of Asphalt in Highway Construction" is the title of Circular No. 24, issued by the Asphalt Association, 25 W. 43rd St., New York. It is an extract of paper read by I. W. Patterson, Chief Engineer, Rhode Island State Board of Public Roads, at a convention of the Canadian Good Roads Assn.

Asphalt Paving—The Asphalt Association, 25 W. 43rd St., New York, recently issued the following new publications: "How American Cities Are Paved." This is Circular No. 9, giving the results of a comprehensive paving census showing that asphalt is the most widely used paving material. Circular No. 22, by Prevost Hubbard, gives results of the Bates Road experiments in 1922 with special reference to asphalt pavements.

ENGINEERING EMPLOYMENT SHOWS SLIGHT RECESSION

Employment conditions affecting engineers reflect considerable irregularity with special divergencies between the trends in different industries and engineering endeavors is reported by the Employment Department of the American Association of Engineers. Numerous inquiries are being received from men from all sections of the country, desiring to make new affiliations, or who report the completion of their work, indicating that a slight recession in employment is apparent. In September there was practically no unemployment among engineers, but during October some unemployment was noticed in different quarters. Engineering employment from now on will continue to slacken from the normal trend of conditions, and no apparent advance will be noticed until about Feb. 15, 1924.

The engineers mostly affected at this time are civil engineers, particularly those on construction work including superintendents, instrumentmen, and general field engineers; also engineers with oil companies in the mid-continent field. There is practically no demand for men on irrigation, drainage, hydraulic or construction work at this time. Manufacturing and industrial companies have reduced their technical staff although a few lines continue activity, such as machine tools, railway equipment and automobile manufacturers. The greatest demand at this time is for architectural engineers and draftsmen. A fair demand is evident for highway engineers, especially designers on plans and bridges. The railroad field for engineers is practically dormant. The electrical industry is fair with a good demand for junior men for minor positions and a fair demand for a few electrical technical experts. The chemical and mining fields have not shown any changes in employment.

Positions for engineers on the Pacific Coast and Southern California are fair. In the Northwest, conditions are tightening up with little work for engineers in the states of Washington, Montana and Idaho. The central states are fair for employment. The Eastern section is not very desirable for employment; more men looking for positions open. The South is starting considerable activity with a good demand for engineers of the junior grade. The greatest unemployment of engineers at the present time is in the Northwest and in the Eastern section of the country.

FORCE ACCOUNT CONSTRUCTION

To the Editor:—

I noted with interest your publication of my paper before the Public Ownership Conference at Toronto, on Page 189 of your October, 1923 issue, and also the editor's introductory note on same.

The only thing I have to criticise about the note is the use of the word "enthusiastic." I may have been enthusiastic on this point when I went to Milwaukee in 1910, and was 26 years old, but I can assure you that, now that I am in my fortieth year, the enthusiasm has quite cooled down. My conviction on the point still remains, but it is based on a great many years of careful consideration of the subject, and experience with work done both by day labor and by contract.

Very truly yours,

CHARLES A. MULLEN.

Director of Paving Department, Milton Hersey Co., Ltd., 84 St. Antoine St. Montreal, Quebec, Oct. 26, 1923.